

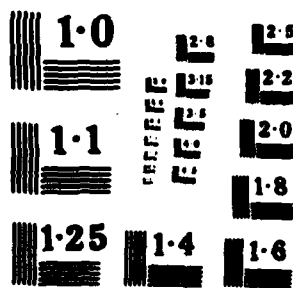
UNCLASSIFIED

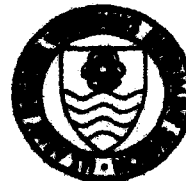
OC1 84 WES-MISS-BASIN MODEL-31-19

F/G 13/2

NL

END
DATE
FILED
A 85
FBI





MISSISSIPPI BASIN MODEL REPORT 31-9

**EFFECTS OF VARIOUS LEVEE
ALIGNMENTS AND GRADES ON 1973 AND
PROJECT DESIGN FLOWLINES IN THE
RED-OUACHITA-BLACK RIVER BASIN**

by

James E. Foster, James V. Allen, J. Edwin Glover

Hydraulics Laboratory

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
PO Box 631
Vicksburg, Mississippi 39180-0631

October 1984

Final Report

Approved For Public Release; Distribution Unlimited

AD-A151 548

E

AD-A151 548

INNOVATION: BAKIN MODEL IMPROVES
Issued Prior to and Including This Quarter

Report No.	Title
1-1	Preliminary Report on Proposed Reservoir Operation Model, Mississippi River and Tributaries
1-2	Report on Proposed Site
1-3	Salinity Project Report
1-4	Description of the Mississippi Basin Model
1-5	Automatic Instrumentation of the Mississippi Basin Model
1-6	History and Description of the Mississippi Basin Model
2-1	Report of First Meeting of Mississippi Basin Model Board
2-2	Report of Second Meeting of Mississippi Basin Model Board
2-3	Report of Third Meeting of Mississippi Basin Model Board
2-4	Report of Fourth Meeting of Mississippi Basin Model Board
2-5	Report of Fifth Meeting of Mississippi Basin Model Board
2-6	Report of Sixth Meeting of Mississippi Basin Model Board
2-7	Report of Seventh Meeting of Mississippi Basin Model Board
2-8	Report of Eighth Meeting of Mississippi Basin Model Board
2-9	Report of Ninth Meeting of Mississippi Basin Model Board
2-10	Report of Tenth Meeting of Mississippi Basin Model Board
2-11	Report of Eleventh Meeting of Mississippi Basin Model Board
2-12	Report of Twelfth Meeting of Mississippi Basin Model Board
2-13	Report of Thirteenth (Fiscal Year 1957) Meeting of Mississippi Basin Model Board
2-14	Report of Fourteenth (Fiscal Year 1958) Meeting of Mississippi Basin Model Board
2-15	Report of Fifteenth (Fiscal Year 1959) Meeting of Mississippi Basin Model Board
2-16	Report of Sixteenth Meeting of Mississippi Basin Model Board, Fiscal Year 1960
2-17	Special Report of the Mississippi Basin Model on Contribution of Model Limits (Seventeenth Meeting of the Board)
2-18	Report of Eighteenth Meeting of Mississippi Basin Model Board, Fiscal Year 1961
2-19	Report of Nineteenth Meeting of Mississippi Basin Model Board
2-20	Report of Twentieth Meeting of Mississippi Basin Model Board
2-21	Report of Twenty-First Meeting of Mississippi Basin Model Board
2-22	Report of Twenty-Second Meeting of Mississippi Basin Model Board
2-23	Report of Twenty-Third Meeting of Mississippi Basin Model Board
2-24	Report of Twenty-Fourth Meeting of Mississippi Basin Model Board
2-25	Report of Twenty-Fifth Meeting of Mississippi Basin Model Board
2-26	Report of Twenty-Sixth Meeting of Mississippi Basin Model Board
2-27	Report of Twenty-Seventh Meeting of Mississippi Basin Model Board
3-1	The Mississippi Basin Model
10-1	Verification of Steam City-to-Hermann Reach, Missouri River and Tributaries, 1939 and 1947 Floods
10-2	Verification of Steam City-to-Mouth Reach, Missouri River and Tributaries, 1939 and 1947 Floods
10-3	Verification of the Pallwinck-Saw-Kentucky River Reach, Tennessee River and Tributaries, 1939 and 1949 Floods
10-4	Verification of Tulsa-to-Van Buren Reach, Arkansas River and Tributaries, Spring 1941 and 1950 Floods
10-5	Verification of Van Buren-to-Pine Bluff Reach, Arkansas River and Tributaries, Spring 1941 and 1950 Floods
10-6	Verification of Hannibal-to-St. Louis Reach, Mississippi River and Tributaries, 1947, 1954, and 1958 Floods
10-7	Verification of Hannibal-to-Tulsa Reach, Mississippi River and Tributaries, 1947, 1954, and 1958 Floods
20-1	Study of Reservoirs and Effects of Steady-Flow Tests, Cumberland River
20-2	Study of Reservoir Steady Flow Profiles and Effects of Pulsed Discharge Profiles on Downstream Steady Flow
20-3	Study of Oscillatory and Surging Reservoirs and Coordinated Operation of Surging and Steady Reservoirs, Cumberland and Tennessee Rivers
20-4	Flood-Routing and Reservoir-Operation Study, Tulsa-to-Van Buren Reach, Arkansas River and Tributaries
20-5	Comparative Routing Program
20-6	Operation of the State Flood-Relief Model Facility
20-7	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-8	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-9	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-10	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-11	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-12	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-13	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-14	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-15	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-16	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-17	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-18	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-19	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-20	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-21	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-22	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-23	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-24	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-25	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-26	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-27	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-28	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-29	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-30	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-31	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-32	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-33	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-34	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-35	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-36	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-37	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-38	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-39	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-40	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-41	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-42	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-43	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-44	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-45	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-46	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-47	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-48	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-49	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-50	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-51	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-52	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-53	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-54	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-55	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-56	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries
20-57	Adaptation of Flood Control Models to Hannibal-to-Tulsa Reach, Mississippi River and Tributaries

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Mississippi Basin Model Rpt 31-9	2. GOVT ACCESSION NO. AISI 348	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) EFFECTS OF VARIOUS LEVEE ALIGNMENTS AND GRADES ON 1973 AND PROJECT DESIGN FLOW LINES IN THE RED-OUACHITA-BLACK RIVER BASIN; Hydraulic Model Investigation		5. TYPE OF REPORT & PERIOD COVERED Final Report
7. AUTHOR(s) James E. Foster James V. Allen J. Edwin Glover		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Engineer Waterways Experiment Station Hydraulics Laboratory PO Box 631, Vicksburg, Miss. 39180-0631		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Engineer District, Vicksburg PO Box 60 Vicksburg, Miss. 39180-0060		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE October 1984
		13. NUMBER OF PAGES 60
		15. SECURITY CLASS (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Available from National Technical Information Service, 5285 Port Royal Road, Springfield, Va. 22161.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Flood control Hydraulic models Levees Red River Basin		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) -This study was conducted on the Vicksburg-to-Baton Rouge reach of the Mississippi Basin Model, a fixed-bed model of the Mississippi River and its tributaries built to a horizontal scale of 1 to 2,000 and a vertical scale of 1 to 100. The tests were conducted to determine what effect various align- ments of project levees would have on the flow line of the 1973 flood and the Ouachita River Project Design (OPD) flood meeting the 1945 flood. Results of the study will be used to assist personnel of the Vicksburg District in (Continued)		

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

20. ABSTRACT (Continued).

determining the optimum location and grade of these levees. Test results indicate that:

- a. Installing Jonesville-to-Larto Lake, Tensas-Cocodrie, Sicily Island, Bushley Bayou, Blue Cane Bend, and South of Red River levees to confining grade; installing Delta Farm levee to existing conditions; and installing a plug in the entrance to Bushley Bayou to el 60 would increase crest stages along the Red River to above Moncla and along the Black and Ouachita Rivers to above Riverton for both the 1973 flood and OPD flood. The maximum increase in flood crest stages would be 1.8 ft at Harrisonburg with the 1973 flood and 1.9 ft at Clayton with the OPD flood.
- b. Raising the water surface at Acme 4.8 ft (from el 56.5 to el 61.3) with the levees installed as described in subparagraph a above would raise OPD flood crests to upstream of Monroe. The increase in crest stages would range from 4.8 ft at Acme to 1.7 ft at Jonesville to 0.2 ft at Monroe.
- c. Installing the South of Red River levee to confining grade with the other levees installed as described in subparagraph a above would raise OPD flood crests from Clayton to Old River Diversion Channel. The maximum increase would be 0.4 ft at Acme.
- d. With the levees installed as described in subparagraph a above, degrading the plug in the entrance to Bushley Bayou from el 60 to el 58 when it is overtopped would lower crest stages from Fort Necessity to Jonesville with a maximum decrease of 0.2 ft at Harrisonburg. Removing this plug when it is overtopped would lower crest stages from Riverton to mile 15.2 with a maximum reduction of 1.1 ft at Harrisonburg.
- e. Installing a 1,000-ft-wide confining riverbank floodway around the west side of Larto Lake, raising Delta Farm levee to confining grade with other levees installed as described in subparagraph a above, would raise OPD flood crest stages in the Ouachita-Black River Basin upstream of Larto Lake by as much as 0.4 ft and lower those downstream by as much as 0.1 ft. Red River crest stages upstream of the floodway would be raised as much as 4.0 ft.

DTIC
ELECTE
S MAR 8 1985 D
B



Accession For	
NTIS	GRA&I <input checked="" type="checkbox"/>
DTIC	TAB <input type="checkbox"/>
Unannounced <input type="checkbox"/>	
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

Preface

This study was conducted on the Mississippi Basin Model (MBM) for the US Army Engineer District, Vicksburg (LMK), by the US Army Engineer Waterways Experiment Station (WES) during the period February-April 1976. The tests were requested by Mr. Phil Combs of LMK during a visit to the MBM in February 1976. Preliminary results were furnished to personnel of LMK upon completion of the tests.

The investigation was conducted in the Hydraulics Laboratory under the general supervision of Messrs. H. B. Simmons and F. A. Herrmann, *et al.*, Chief and Assistant Chief of the Hydraulics Laboratory, and J. E. Glover, Chief of the Waterways Division. The engineer in immediate charge of the model study was Mr. J. E. Foster (retired), former Chief of the River Regulation Branch. He was assisted by Messrs. J. V. Allen, A. I. Fortenberry, C. D. Jones, W. L. Higdon, and D. B. Brister. This report was prepared by Mr. Foster. Data for the report were assembled by Mr. Allen and Mr. Glover reviewed the report.

Commanders and Directors during the course of this investigation and the preparation and publication of this report were COL John L. Cannon, CE, COL Nelson P. Conover, CE, and COL Tilford C. Creel, CE. Technical Director was Mr. F. R. Brown.

Contents

	<u>Page</u>
Preface	1
Conversion Factors, US Customary to Metric (SI) Units of Measurement	3
The Prototype	4
Need for and Purpose of Model Study	4
The Model	6
Test Procedure	6
Test 1	6
Description	6
Results	8
Test 2	8
Description	8
Results	10
Tests 3 and 4	10
Description	10
Results	10
Test 5	11
Description	11
Results	11
Test 6	11
Description	11
Results	11
Test 7	12
Description	12
Results	12
Test 8	12
Description	12
Results	12
Test 9	13
Description	13
Results	13
Test 10	13
Description	13
Results	13
Limitation of Model Results	14
Summary of Results and Conclusions	14
Tables 1 and 2	
Plates 1-43	

Conversion Factors, US Customary to
Metric (SI) Units of Measurement

US customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
feet	0.3048	metres
cubic feet per second	0.2831685	cubic metres per second
miles (US statute)	1.609344	kilometres

EFFECTS OF VARIOUS LEVEE ALIGNMENTS AND GRADES ON 1973 AND PROJECT
DESIGN FLOW LINES IN THE RED-OUACHITA-BLACK RIVER BASIN

Hydraulic Model Investigation

The Prototype

1. The Red-Ouachita-Black River Basin (Figure 1), downstream of Alexandria and Monroe, Louisiana, has a large, relatively flat area with multiple inflows and a single narrow outlet and acts somewhat like a storage reservoir. The area is subject to flooding from excessive rainfall over the Red and Ouachita Basins and from Mississippi River flood flows through the Old River Diversion Channel. The only outlet from the area is the Atchafalaya River at Simmesport, Louisiana. Some of this area is protected by levees, but these levees have been designed to be overtopped by the Mississippi River Project Design flood to reduce downstream flooding at critical locations along the Mississippi and Atchafalaya Rivers. There are proposed levees that will provide protection for additional areas. These levees are also to be designed to be overtopped by the Mississippi River Project Design flood, but they could increase upstream stages for floods of lesser magnitude.

Need for and Purpose of Model Study

2. During and since the 1973 flood, the highest recent flood in the lower portion of the Red River, changes have occurred in the channels that have altered rating curves at various points in the Red, Old, and Atchafalaya Rivers. Also, since the 1973 flood, some major levees have been built or raised. These levee changes also affected the stage-discharge relationships in the basin. Analytical determination of the changes to stages and the solution to problems developing in this area with its multiple inflows, backwater effect from the Mississippi River, and extremely large natural storage area are complex and uncertain. Therefore it was decided that tests should be conducted on the Mississippi Basin Model (MBM) to provide additional information that could be used in conjunction with analytical data to develop reliable stage predictions for various conditions. The specific purposes of these tests were to assist the US Army Engineer District, Vicksburg (LMK), in determining the stages that would result from the Ouachita River Project Design (OPD) flood with levees to existing conditions and with proposed and some existing levees to confining grade.

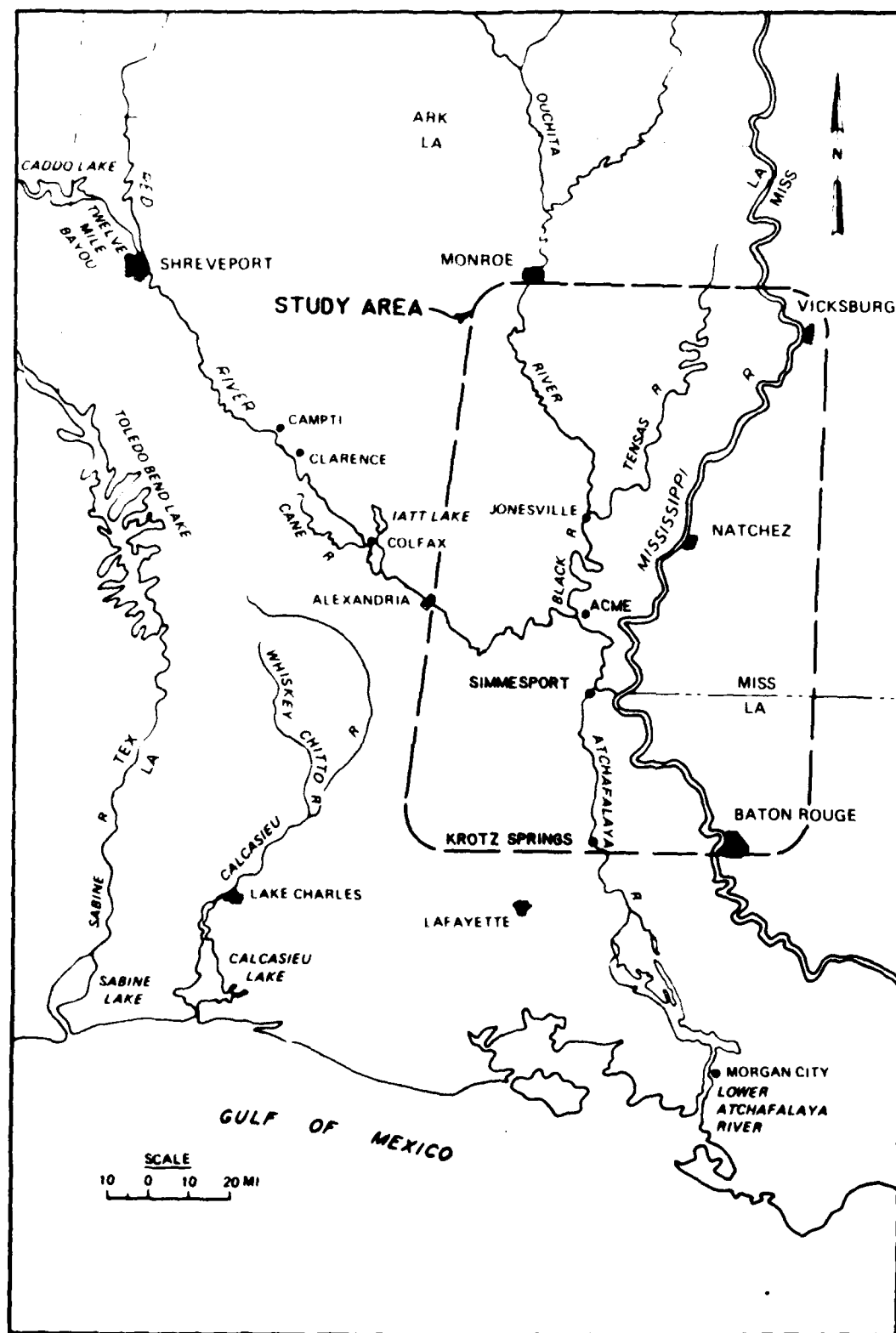


Figure 1. Location map

The Model

3. These tests were conducted on the Mississippi River portion of the MBM from Vicksburg, Mississippi, to Baton Rouge, Louisiana, including the Red River upstream to Alexandria, Louisiana, the Ouachita River upstream to Monroe, Louisiana, and the Black and Tensas Rivers and the Atchafalaya River downstream to Krotz Springs, Louisiana (Figure 2). The MBM is a fixed-bed model of the Mississippi River and its tributary system built to a horizontal scale of 1:2,000 and a vertical scale of 1:100. This model, including appurtenances, instrumentation, and operation procedure, is described in detail in Mississippi Basin Model Report Number 1-4, Description of Mississippi Basin Model, dated July 1951. The portion of the model used for these tests was adjusted to reproduce stages of the 1973 flood for the period 10 March-31 May as shown by the results of Test 1.

Test Procedure

4. Ten tests (eight hydrograph and two steady flow) were conducted in this study. Two of the hydrograph tests (Tests 1 and 2) used flows that occurred in the prototype during the period 10 March-31 May 1973 and six tests (Test 5-10) used OPD flood flows with the 1945 flood flows on the Mississippi and Red Rivers. These flows were introduced at model inflow points shown in Figure 2 and routed to Baton Rouge on the Mississippi River and Krotz Springs on the Atchafalaya River where the water surfaces were held to 1973 prototype stages or to rating curves developed from 1973 prototype data. These tests were conducted with levees to conditions existing in 1973 and with some existing and proposed levees to confining grades.

5. The two steady-flow tests (Tests 3 and 4) used flows simulating the crest of the OPD flood. These steady flows were routed to Simmesport, Louisiana, on the Atchafalaya River where the water surface was controlled to produce a given elevation at Acme. These tests were conducted with some levees to 1973 conditions and others to proposed alignment and to confining grades.

6. No levees were crevassed during any of these tests. Water-surface elevations were recorded at model gaging stations for all tests. Discharges were measured at Baton Rouge and Krotz Springs for all tests and at Morganza Floodway structure for tests of the 1973 flood. Table 1 lists the variable conditions for each test and Table 2 lists the resulting crest water-surface elevations for each test.

Test 1

Description

7. The 1973 flood flows, used for verification of this reach of the model and

The Model

3. These tests were conducted on the Mississippi River portion of the MBM from Vicksburg, Mississippi, to Baton Rouge, Louisiana, including the Red River upstream to Alexandria, Louisiana, the Ouachita River upstream to Monroe, Louisiana, and the Black and Tensas Rivers and the Atchafalaya River downstream to Krotz Springs, Louisiana (Figure 2). The MBM is a fixed-bed model of the Mississippi River and its tributary system built to a horizontal scale of 1:2,000 and a vertical scale of 1:100. This model, including appurtenances, instrumentation, and operation procedure, is described in detail in Mississippi Basin Model Report Number 1-4, Description of Mississippi Basin Model, dated July 1951. The portion of the model used for these tests was adjusted to reproduce stages of the 1973 flood for the period 10 March-31 May as shown by the results of Test 1.

Test Procedure

4. Ten tests (eight hydrograph and two steady flow) were conducted in this study. Two of the hydrograph tests (Tests 1 and 2) used flows that occurred in the prototype during the period 10 March-31 May 1973 and six tests (Test 5-10) used OPD flood flows with the 1945 flood flows on the Mississippi and Red Rivers. These flows were introduced at model inflow points shown in Figure 2 and routed to Baton Rouge on the Mississippi River and Krotz Springs on the Atchafalaya River where the water surfaces were held to 1973 prototype stages or to rating curves developed from 1973 prototype data. These tests were conducted with levees to conditions existing in 1973 and with some existing and proposed levees to confining grades.

5. The two steady-flow tests (Tests 3 and 4) used flows simulating the crest of the OPD flood. These steady flows were routed to Simmesport, Louisiana, on the Atchafalaya River where the water surface was controlled to produce a given elevation at Acme. These tests were conducted with some levees to 1973 conditions and others to proposed alignment and to confining grades.

6. No levees were crevassed during any of these tests. Water-surface elevations were recorded at model gaging stations for all tests. Discharges were measured at Baton Rouge and Krotz Springs for all tests and at Morganza Floodway structure for tests of the 1973 flood. Table 1 lists the variable conditions for each test and Table 2 lists the resulting crest water-surface elevations for each test.

Test 1

Description

7. The 1973 flood flows, used for verification of this reach of the model and

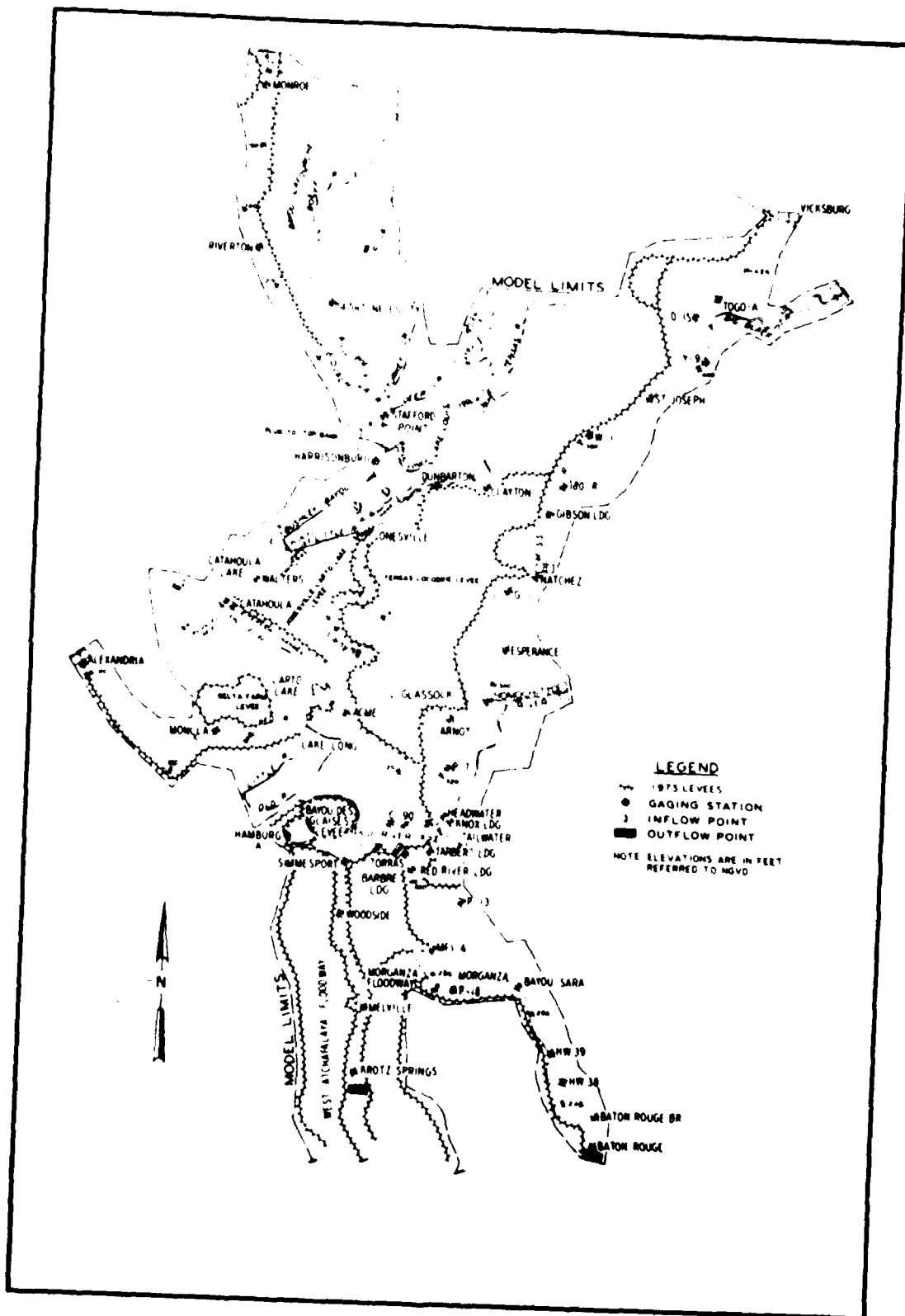


Figure 2. Test reach of the Mississippi Basin Model

shown in Plates 1 and 2, were introduced at model inflow points downstream from Vicksburg (Figure 2). The flows at Vicksburg were those measured on the model during verification tests routed from Memphis, Tennessee. These flows were routed to the Morganza Floodway structure and Baton Rouge on the Mississippi River and to Krotz Springs on the Atchafalaya River where water surfaces were held to those recorded during 1973. Old River and Morganza Floodway structures were operated as they were during 1973. Levees were to conditions existing in 1973 as shown in Figures 2 and 3.

Results

8. The resulting stage and discharge hydrographs are compared with available prototype data in Plates 3-15. These results show that the model satisfactorily reproduced prototype stages and discharges. Model crest stages were within 1/2 ft* of the prototype published stages except at high-water gages 180R and Gibson Landing (Plate 4). These were 0.7 ft above the prototype readings. The model discharge hydrographs reproduced the general shape of the prototype discharge hydrographs over the crest at Baton Rouge and Krotz Springs even though they did not reproduce the erratic fluctuations of the prototype (as much as 130,000 cfs in a total of 1,300,000 cfs in a period of two days). The model discharge at Baton Rouge was within 4 percent of the published discharge just prior to the crest and within 1 percent on the crest. The model discharge at Krotz Springs was within 2 percent of the published discharge just prior to the crest and agreed with the published discharge on the crest. The Morganza Floodway discharges agreed with the published discharges within about 5 percent.

Test 2

Description

9. Test 2 was the same as Test 1 except that:
- a. Sicily Island, Bushley Bayou, Blue Cane Bend, and South of Red River levees were installed to confining grades along proposed alignments furnished by LMK as shown in Figure 3.
 - b. Jonesville to Larto Lake levee was completed as shown in Figure 3 and raised to confining grade. This levee was completed after the 1973 flood.
 - c. Delta Farm levee was extended to reflect existing conditions (Figure 3). This extension was constructed after the 1973 flood.
 - d. Tensas-Cocodrie levee was raised to confining grade.

* A table of factors for converting US customary units of measurements to metric (SI) units is presented on page 3.

- c. A plug was installed in the entrance to Bushley Bayou to el 60.*
- f. The water surfaces at Baton Rouge and Krotz Springs were held to rating curves developed by LMK from 1973 prototype stages and discharges.

Results

10. The resulting stage and discharge hydrographs are compared with those for Test 1 in Plates 3-15. These results indicate that reducing valley storage by (a) making the proposed and some of the existing levees to confining grade, (b) extending the Delta Farm levee to existing alignment and grade, and (c) installing a plug in Bushley Bayou to el 60 would increase 1973 crest stages from Moncla on the Red River and Riverton on the Ouachita River to Woodside on the Atchafalaya River. The maximum increase in crest stages was 1.8 ft at Harrisonburg (Plate 10). This increase in Red-Ouachita River Basin crest stages had little, if any, effect on Mississippi River crest stages as indicated by the Old River Headwater hydrographs in Plate 6. However, holding Baton Rouge stages to the rating curve furnished by LMK raised Mississippi River stages from P-7 (just above Old River) to Baton Rouge. The maximum increase in Mississippi River crest stages was 0.6 ft at Baton Rouge. Decreasing the valley storage in the Red-Ouachita River Basin increased the discharges on the rising side of the hydrograph at Krotz Springs (Plate 15) by as much as 30,000 cfs but had little effect on the crest portion of this hydrograph or the hydrograph at Morganza Floodway.

Tests 3 and 4

Description

11. Steady flows of 120,000 cfs on the Ouachita River, 30,800 cfs on the Boeuf River, and 25,200 cfs on the Tensas River (simulating the crest of the OPD flood) were introduced at model inflow points (Figure 2) for Tests 3 and 4. These flows were routed to Simmesport where the water surface was held first to el 55.9 for Test 3, to produce an elevation of 56.5 at Acme, and then to el 61.1 for Test 4, to produce an elevation of 61.3 at Acme. The model conditions for both tests were the same as they were for Test 2 (Figure 3).

Results

12. The water-surface elevations recorded for Tests 3 and 4 (Table 2) indicate that with the proposed and existing levees shown in paragraph 9 to confining grade, raising the water surface at Acme 4.8 ft (from el 56.5 to el 61.3) would raise OPD

* All elevations (el) cited herein are in feet referred to the National Geodetic Vertical Datum of 1929 (NGVD).

flood stages to upstream of Monroe. The increase in stages ranged from 4.8 ft at Acme, to 1.7 ft at Jonesville, to 0.4 ft at Riverton, to 0.2 ft at Monroe. These differences can be used to indicate crest elevations to be expected with the OPD flood meeting floods of a lesser magnitude than the 1945 flood.

Test 5

Description

13. Test 5 was the same as Test 1 except that:
 - a. The OPD flood flows were introduced on the Ouachita, Boeuf, and Tensas Rivers and in Catahoula Lake. The 1945 flood flows were introduced on the Mississippi and Red Rivers. The 1945 flood flows at Natchez on the Mississippi River were modified in an effort to produce a crest water surface at Acme of about el 61.3 (actual elevation produced was 61.6 which was considered satisfactory). These inflows are presented in Plates 16 and 17.
 - b. The Tensas-Cocodrie levee was graded to el 61.3 from the Mississippi River main-line levee to Acme and raised to confining grade from Acme to Cynthia Bayou. The remainder of the levee was left to grades existing in 1973.
 - c. Old River Overbank structure was open for the full test period.
 - d. Water surfaces at Baton Rouge and Krotz Springs were held to rating curves developed by LMK from 1973 prototype data (as in Test 2).

Results

14. The resulting stage and discharge hydrographs are presented in Plates 18-30. These results will be used as a base for comparing results of Tests 6-10 to determine the effects of proposed changes in the basin on OPD flood stages.

Test 6

Description

15. Test 6 was the same as Test 5 except for the modifications listed below. With these modification, the model conditions were the same as those for Test 2 except the South of Red River levee was not installed.

- a. Sicily Island, Bushley Bayou, and Blue Cane Bend levees were installed to confining grades along proposed alignments shown in Figure 3.
- b. Jonesville-to-Larto Lake levee was completed as shown in Figure 3 and raised to confining grade.
- c. Delta Farm levee was extended to reflect existing conditions (Figure 3).
- d. Tensas-Cocodrie levee was raised to confining grade.
- e. A plug was installed in the entrance to Bushley Bayou to el 60.0.

Results

16. The resulting stage and discharge hydrographs are presented in Plates 31-43. A comparison of these hydrographs with those of Test 5 indicates that the proposed and existing levees indicated in paragraph 15 to confining grade, extending Delta Farm levee to existing alignment and grade, and installing a plug in Bushley Bayou to el 60 would increase crest stages of the OPD flood in the Ouachita-Red-Black River Basin from above Riverton and Moncla to Krotz Springs and on the Mississippi River from Natchez to Baton Rouge. The Ouachita River Basin crest stages were increased a maximum of 1.7 ft at Clayton. The crest stage at Acme was raised 0.4 ft and at Riverton, 0.5 ft. The Mississippi River crest stages were increased 0.2 to 0.3 ft from Esperance to Baton Rouge with a 0.3-ft increase at Old River Headwater.

Test 7

Description

17. Test 7 was the same as Test 6 except that the South of Red River levee was installed to confining grade along the proposed alignment furnished by LMK and shown in Figure 3. The model conditions for Test 7 were the same as those for Test 2.

Results

18. The resulting stage and discharge hydrographs for Test 7 are shown compared with those of Test 6 in Plates 31-43. These results indicate that installing the South of Red River levee to confining grade with the Jonesville-to-Larto Lake, Tensas-Concordie, Sicily Island, Bushley Bayou, and Blue Cane Bend levees to confining grade, the Delta Farm levee to existing condition, and a plug in Bushley Bayou to el 60 (Tests 6 versus 7) would raise crest stages from Clayton to Old River Diversion Channel with a maximum increase of 0.4 ft at Acme. Installing this levee had no effect on Mississippi River crest stage. A comparison of the differences between Tests 5 and 7 with those between Tests 1 and 2 indicates that the modifications for Test 7 would have about the same effect on crest stages of the OPD flood as on crest stages of the 1973 flood even though the crest of the OPD flood was as much as 4.7 ft higher than the crest of the 1973 flood.

Test 8

Description

19. Test 8 was the same as Test 7 except that the plug in the entrance to Bushley Bayou was degraded to el 58 when it was overtopped.

Results

20. The resulting stage and discharge hydrographs for Test 8 are shown compared with those of Test 7 in Plates 18-30. These results indicate that degrading the plug in Bushley Bayou to el 58 when it is overtopped would lower crest stages from Fort Necessity to Jonesville on the Ouachita River with a maximum decrease of 0.2 ft at Harrisonburg. Other stages in the test reach were not affected.

Test 9

Description

21. Test 9 was the same as Test 7 except that the plug in the entrance to Bushley Bayou was removed when it was overtopped.

Results

22. The resulting stage and discharge hydrographs for Test 9 are shown compared with those of Test 7 in Plates 18-30. These results indicate that removing the plug in the entrance to Bushley Bayou when it is overtopped would lower Black-Ouachita River crest stages from Riverton to mile 15.2 with a maximum of 1.1 ft at Harrisonburg. Other crest stages in the test reach were not affected.

Test 10

Description

23. Test 10 was the same as Test 9 except that the Delta Farm levee was raised to confining grade, the Larto Lake levee was installed to confining grade along the proposed alignment, and a 1,000-ft-wide overbank floodway was installed from mile 6.6 in Catahoula Lake Diversion Canal around the west side of Larto Lake to the Red River 6.2 miles upstream of the mouth of the Black River. Confining levees were installed along each side of the floodway.

Results

24. The resulting stage and discharge hydrographs for Test 10 are presented in Plates 31-43 and the crest water-surface elevations are listed in Table 2. A comparison of the resulting hydrographs and crest water-surface elevations for Tests 9 and 10 indicates that raising the Delta Farm levee to confining grade and installing a 1,000-ft-wide floodway around the west side of Larto Lake would raise crest water-surface elevations in the Ouachita River Basin upstream of the Larto Lake levee by as much as 0.4 ft and lower the crest elevations downstream of this levee by 0.1 ft. The Red River crest elevations upstream of the 1,000-ft-wide floodway were raised as much as 4.0 ft (Moncla). Other crest stages were unaffected.

Limitation of Model Results

25. In evaluating the results of these tests it should be considered that:
- a. The Mississippi Basin Model is a fixed-bed model and does not reflect channel bed changes with changes in flow and water-surface slope.
 - b. The model was adjusted to reproduce stage-discharge relationships at the 1973 flood and does not reflect channel bed changes that may have occurred in the prototype since 1973.
 - c. Some of the tests were conducted with steady flows that could produce higher stages than hydrograph flows with crests of equal inflow because all valley storage is satisfied with steady flows and is not with hydrograph flows.
26. In spite of the above limitations, the adjustment of the model was sufficient to indicate that the recorded stages and discharges are reasonable reproductions of those expected to occur in the prototype under the conditions tested.

Summary of Results and Conclusions

27. Results of these tests provide water-surface elevations to be expected on the Mississippi River from Vicksburg, Mississippi, to Baton Rouge, Louisiana, in the Red-Ouachita-Black River Basin and on the Atchafalaya River from Simmesport, Louisiana, to Krotz Springs, Louisiana, for flows at the 1973 and OPD floods with existing and proposed levees in the Red-Ouachita-Black River Basin to various alignments and grades. Results of this study will be used to assist personnel at the Vicksburg District in determining the optimum location and grade of these levees. Test results indicate that:

- a. Completing the Jonesville-to-Larto Lake levee and raising it to confining grade; extending the Delta Farm levee to existing alignment and grade; raising the Tensas-Cocodrie levee to confining grade; installing Sicily Island, Bushley Bayou, Blue Cane Bend, and South of Red River levees to confining grade; and installing a plug in the entrance to Bushley Bayou to el 60 (Test 1 versus 2) would increase 1973 flood crest stages from Moncla on the Red River and Riverton on the Ouachita River to Woodside on the Atchafalaya River. The maximum increase would be 1.8 ft at Harrisonburg. These changes increased the discharge on the rising side of the hydrograph at Krotz Springs but had little effect on the crest discharges.
- b. The changes listed in a above would have about the same effect on crest stages of the OPD flood (Test 5 versus 7) as on the crest stages of the 1973 flood (Test 1 versus 2) even though the crest of the OPD flood was as much as 4.7 ft higher than the crest of the 1973 flood.
- c. Raising the water surface at Acme 4.8 ft (from el 56.5 to el 61.3) with the levees installed as described in subparagraph a above (Test 3 versus 4) would raise OPD flood crest stages to upstream of Monroe. The increase in crest stages ranged from 4.8 ft at Acme to 1.7 ft at Jonesville to 0.2 ft at Monroe.

- d. Installing South of Red River levee to confining grade with the other levees installed as described in subparagraph a above (Test 6 versus 7) would raise OPD flood crest stages from Clay to Old River Diversion Channel with a maximum increase of 0.4 ft at Acme.
- e. Degrading the plug in the entrance to Bushley Bayou from el 60 to el 58 when it is overtopped with levees installed as described in subparagraph a above (Test 7 versus 8) would lower crest stages from Fort Necessity to Jonesville with a maximum decrease of 0.2 ft at Harrisonburg.
- f. Removing the plug in the entrance to Bushley Bayou when it is overtopped with levees to conditions described in subparagraph a above (Test 7 versus 9) would lower crest stages of the OPD flood from Riverton to mile 15.2 with a maximum reduction of 1.1 ft at Harrisonburg.
- g. Installing a 1,000-ft-wide confining overbank floodway around the west side of Larto Lake, raising Delta Farm levee to confining grade, and installing Larto Lake levee to confining grade with other levees installed as described in subparagraph a above (Test 9 versus 10) would raise OPD flood crest stages in the Ouachita-Black River Basin upstream of Larto Lake by as much as 0.4 ft and lower those downstream by as much as 0.1 ft. Red River crest stages were raised as much as 4.0 ft.

Table 1
Variable Test Conditions

Test No.	Inflows (See Fig. 2 and Plates 1, 2, 10, and 17)	Diversion Structures Old River Floodway	El of Plug Morganza Bayou	El of Floodway Catahoula Canal to Red River	Jonesville to Larto Lake	Delta Farm	Tensas Cudodrie	Stevie Island	Rushley Bayou	Blue Bend	South River	Larto Lake	Baton Rouge and Kenner Springs	Water surface condition
1	1973 flood flows	1973	1973		1973	1973	1973						1973	N/A
2	1973 flood flows	1973	1973	El 60	Comp and conf	Ext	Conf	Conf	Conf	Conf	Conf		K	N/A
3	OPD flood crest flows	N/A	N/A	El 60	Comp and conf	Ext	Conf	Conf	Conf	Conf	Conf		N/A	El 60.5
4	OPD flood crest flows	N/A	N/A	El 60	Comp and conf	Ext	Conf	Conf	Conf	Conf	Conf		N/A	El 60.5
5	OPD flood meeting 1945 flood	Open	Open		1973	1973	1973 Mod.†						RC	N/A
6	OPD flood meeting 1945 flood	Open	Open	El 60	Comp and conf	Ext	Conf	Conf	Conf	Conf	Conf		RC	N/A
7	OPD flood meeting 1945 flood	Open	Open	El 60	Comp and conf	Ext	Conf	Conf	Conf	Conf	Conf		RC	N/A
8	OPD flood meeting 1945 flood	Open	Open	El 60††	Comp and conf	Ext	Conf	Conf	Conf	Conf	Conf		RC	N/A
9	OPD flood meeting 1945 flood	Open	Open	El 60‡	Comp and conf	Ext	Conf	Conf	Conf	Conf	Conf		RC	N/A
10	OPD flood meeting 1945 flood	Open	Open	El 60‡	Comp and conf	Ext	Conf	Conf	Conf	Conf	Conf	Conf	RC	N/A

* Proposed levees were installed to alignment furnished by LMK.

†† RC indicates Rating Curve developed by LMK from 1973 prototype data.

† 1973 Mod. indicates 1973 alignment to el 61.3 upstream to Acme, to confining grade to Cynthia Bayou, and to 1973 grades upstream to end of levee.

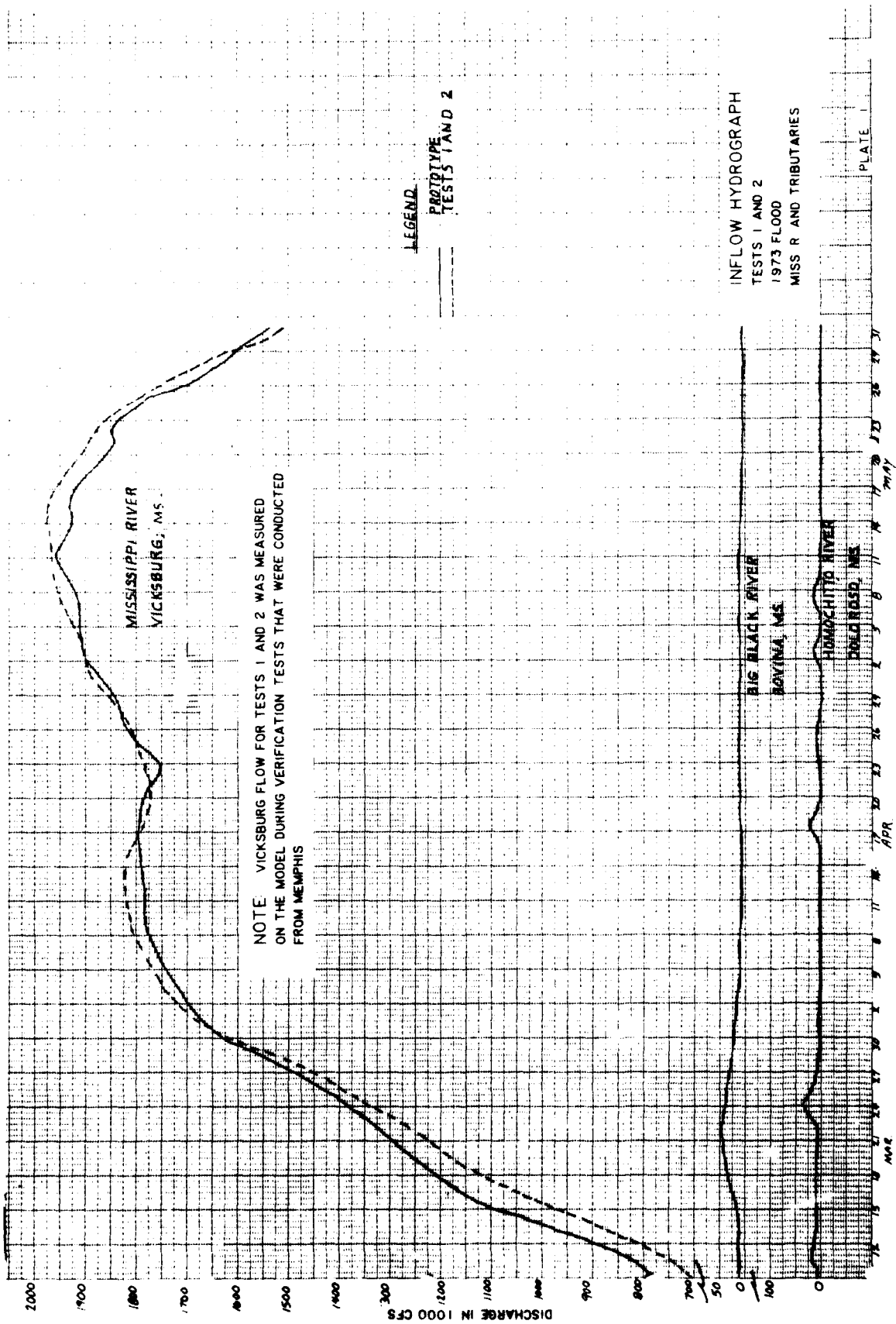
‡ Plug in Bushley Bayou degraded to el 58 when it was overtopped.

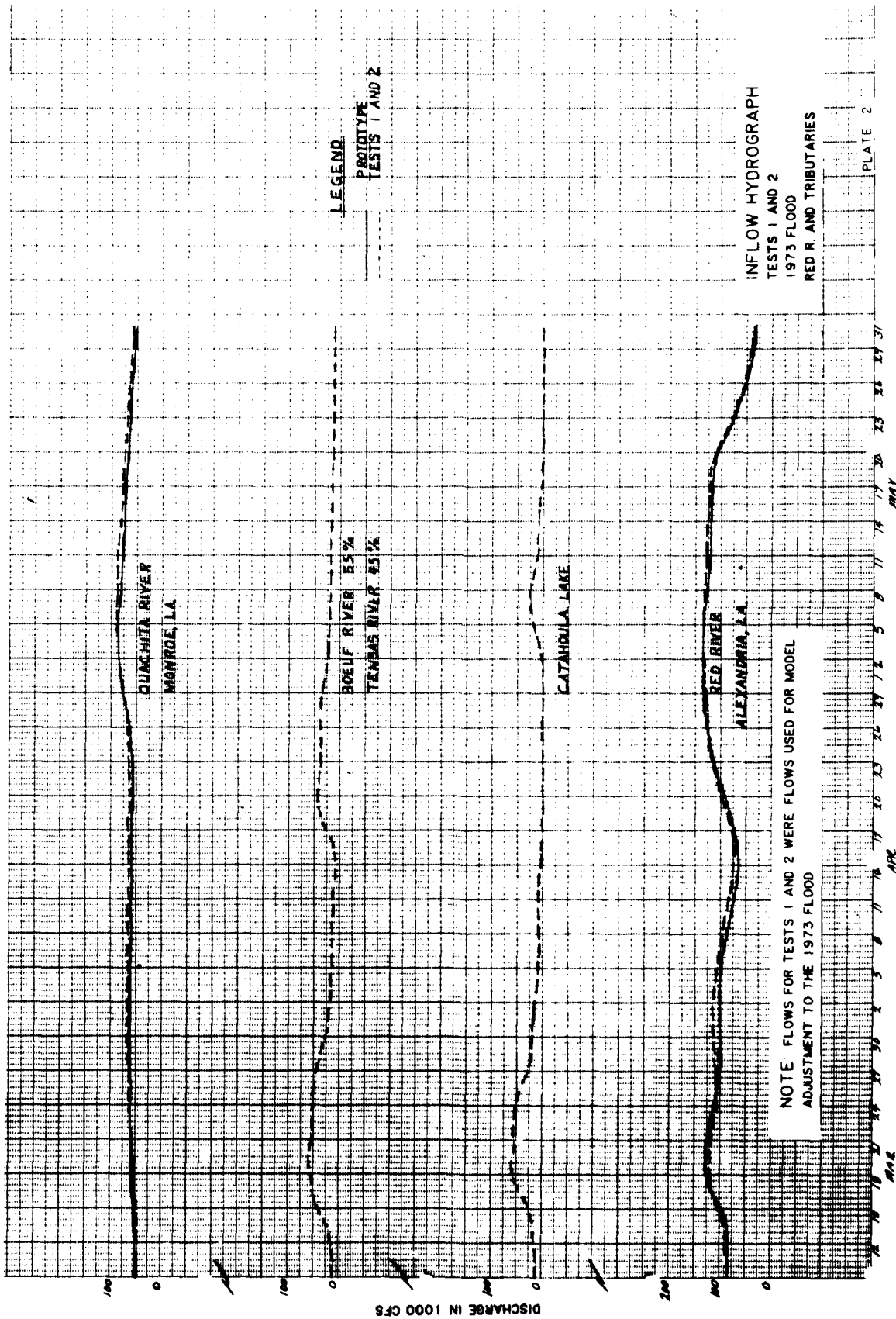
‡‡ A 1,000-ft-wide overbank floodway with confining levees was built from Catahoula Drainage Canal to Red River around west side of Larto Lake.

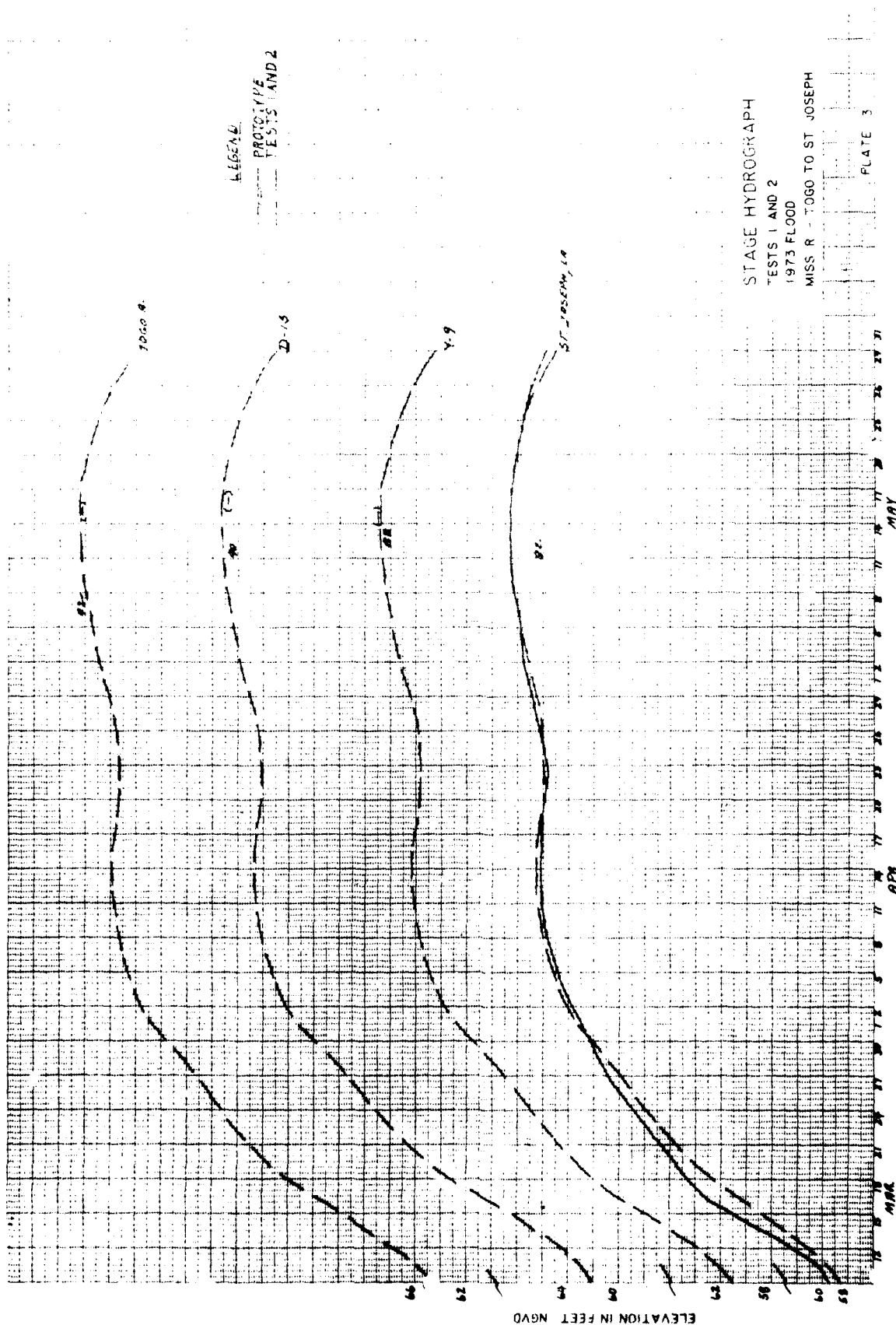
Table 1
Crest Water Surface Elevations

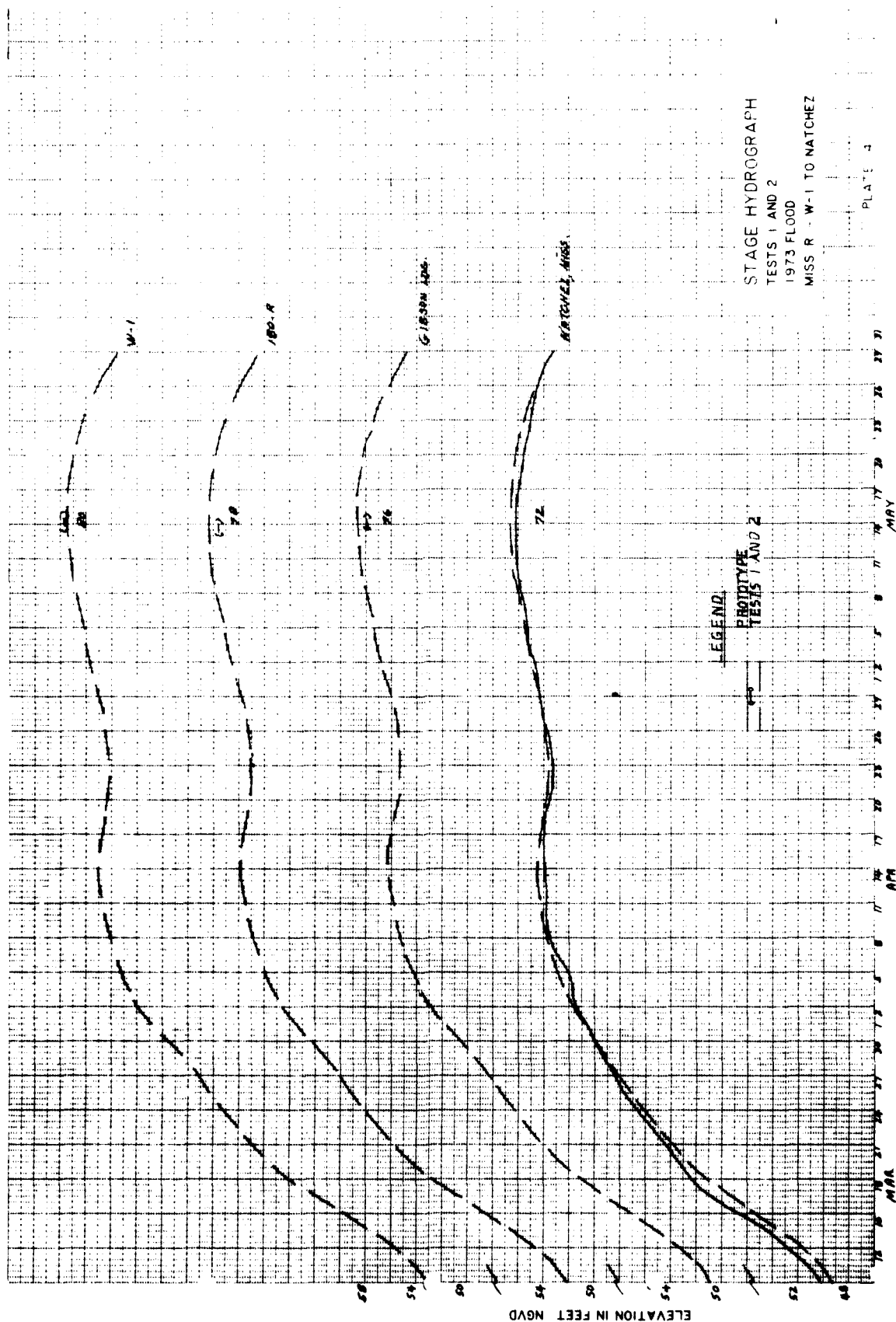
Gaging Station	River	1973 Flood		Steady Flow		1945 Mississippi - P.D.F. Ouachita					
		Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
	Mississippi	70.0	70.0			74.1	74.1	74.1	74.1	74.1	74.1
...	Mississippi	70.4	70.4			72.0	72.2	72.2	72.2	72.2	72.2
...	Mississippi	67.3	67.3			68.9	69.1	69.1	69.1	69.1	69.1
...	Mississippi	66.0	66.0			67.6	67.8	67.8	67.8	67.8	67.8
...	Mississippi	63.9	64.0			65.7	66.0	66.0	66.0	66.0	66.0
...	Old	61.7	61.8			63.5	63.8	63.8	63.8	63.8	63.8
...	Mississippi	61.6	62.0			63.4	63.7	63.7	63.7	63.7	63.7
...	Mississippi	59.6	59.9			61.6	61.9	61.9	61.9	61.9	61.9
...	Mississippi	59.1	59.3			61.1	61.4	61.4	61.4	61.4	61.4
...	Mississippi	58.2	58.7			60.4	60.7	60.7	60.7	60.7	60.7
...	Mississippi	56.0	56.2			58.5	58.8	58.8	58.8	58.8	58.8
...	Mississippi	54.8	55.2			57.3	57.6	57.6	57.6	57.6	57.6
...	Mississippi	53.4	54.0			57.7	56.0	56.0	56.0	56.0	56.0
...	Mississippi	53.0	53.5			55.5	55.8	55.8	55.8	55.8	55.8
...	Mississippi	50.7	51.6			53.2	53.5	53.5	53.5	53.5	53.5
...	Mississippi	47.2	48.0			49.4	49.7	49.7	49.7	49.7	49.7
...	Mississippi	46.0	46.8			48.6	48.9	48.9	48.9	48.9	48.9
...	Mississippi	42.8	43.7			45.1	45.4	45.4	45.4	45.4	45.4
...	Mississippi	41.6	42.5			43.8	44.1	44.1	44.1	44.1	44.1
...	Ouachita	80.5	80.5	85.4	85.6	85.2	85.2	85.2	85.2	85.2	85.2
...	Ouachita	70.7	70.9	75.4	75.8	74.8	75.3	75.3	75.3	75.1	75.1
...	Big Creek	61.6	63.2	65.3	66.2	65.2	66.3	66.3	66.2	65.6	65.6
...	Ouachita	61.5	63.0	65.2	66.1	65.0	66.1	66.1	66.0	65.1	65.5
...	Ouachita	60.7	62.5	64.3	65.5	64.2	65.4	65.4	65.2	64.3	64.5
...	Brushy Bayou	60.1	61.6	64.2	65.4	64.2	65.9	66.1	66.0	65.1	65.4
...	Texas	59.9	61.3	63.3	64.7	63.6	65.0	65.2	65.0	64.2	64.6
...	Black	59.8	61.2	62.1	63.9	63.2	64.1	64.3	64.2	63.3	63.7
...	Black		60.9	60.7	63.2	63.0	63.8	64.1	64.1	63.2	63.4
...	Black		60.5	60.1	63.0	62.8	63.5	63.8	63.8	63.1	63.3
...	Black		60.1	58.1	62.2	62.7	63.3	63.5	63.5	63.0	63.0
...	Black		59.8	57.5	61.6	62.4	62.8	63.0	63.0	62.9	62.9
...	Black		59.5	56.9	61.4	62.0	62.4	62.6	62.6	62.6	62.5
...	Black	58.7	59.2	56.5	61.3	61.7	62.0	62.1	62.3	62.3	62.2
...	Old	59.3	59.3			61.3	61.6	61.6	61.6	61.6	61.5
...	Old	58.6	58.9			61.2	61.5	61.5	61.5	61.5	61.4
...	Old	58.4	58.8			61.2	61.5	61.5	61.5	61.5	61.4
...	Atchafalaya	57.1	57.5			60.0	60.2	60.2	60.2	60.2	60.1
...		59.4	59.7	57.6	61.9	62.5	62.9	63.3	63.3	63.3	63.5
...	Diversion Channel	59.3	59.8	57.4	61.9	62.5	63.0	63.3	63.3	63.3	63.5
...	Diversion Channel		59.9	57.2	61.8		62.9			63.0	63.1
...	Diversion Channel		59.6	57.1	61.7		62.6			62.5	62.7
...	Red	80.0	80.0	57.3	62.0	89.0	89.0	89.0	89.0	89.0	89.6
...	Red	64.8	65.2	57.3	62.0	69.8	70.0	70.0	70.0	70.0	74.0
...	Red			57.2	61.8		62.9				62.8
...				57.0	61.7		62.7				62.5
...	Larto Bayou		59.7	57.0	61.6		62.9				
...	Bayou Des Glaives	56.3	56.8			59.1	59.4	59.4	59.4	59.4	59.4
...	Bayou Des Glaives		56.8			59.2	59.6	59.6	59.6	59.6	59.6
...	Atchafalaya	55.0	55.2	55.9	61.1	57.7	58.1	58.1	58.1	58.1	58.1
...	Atchafalaya	51.8	52.3			54.5	54.9	54.9	54.8	54.8	54.8
...	Atchafalaya	44.2	44.2			46.3	46.5	46.7	46.7	46.7	46.7
...	Atchafalaya	38.2	38.2			40.1	40.2	40.2	40.2	40.2	40.2

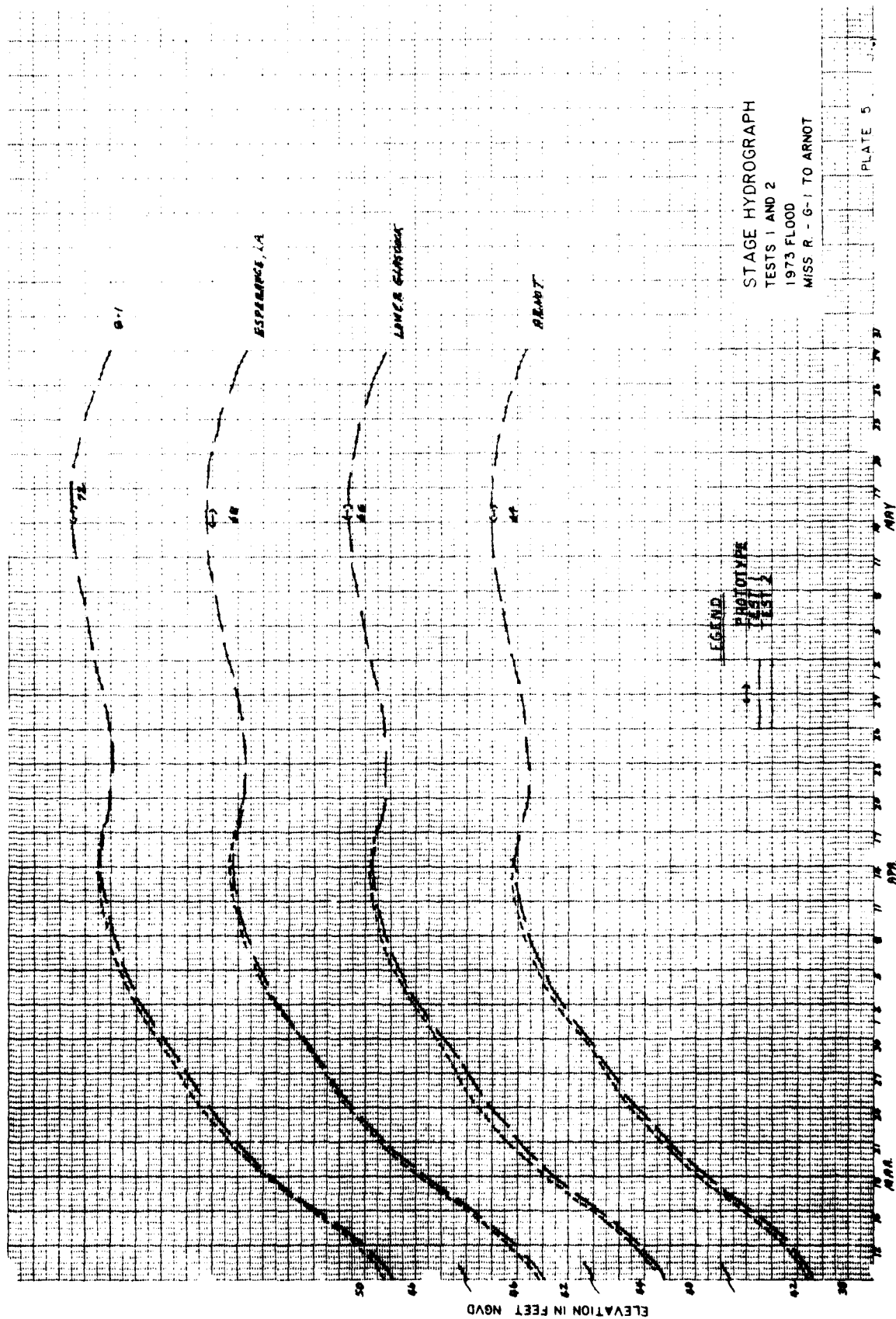
Water-surface elevations are in feet referred to the National Geodetic Vertical Datum (NGVD).

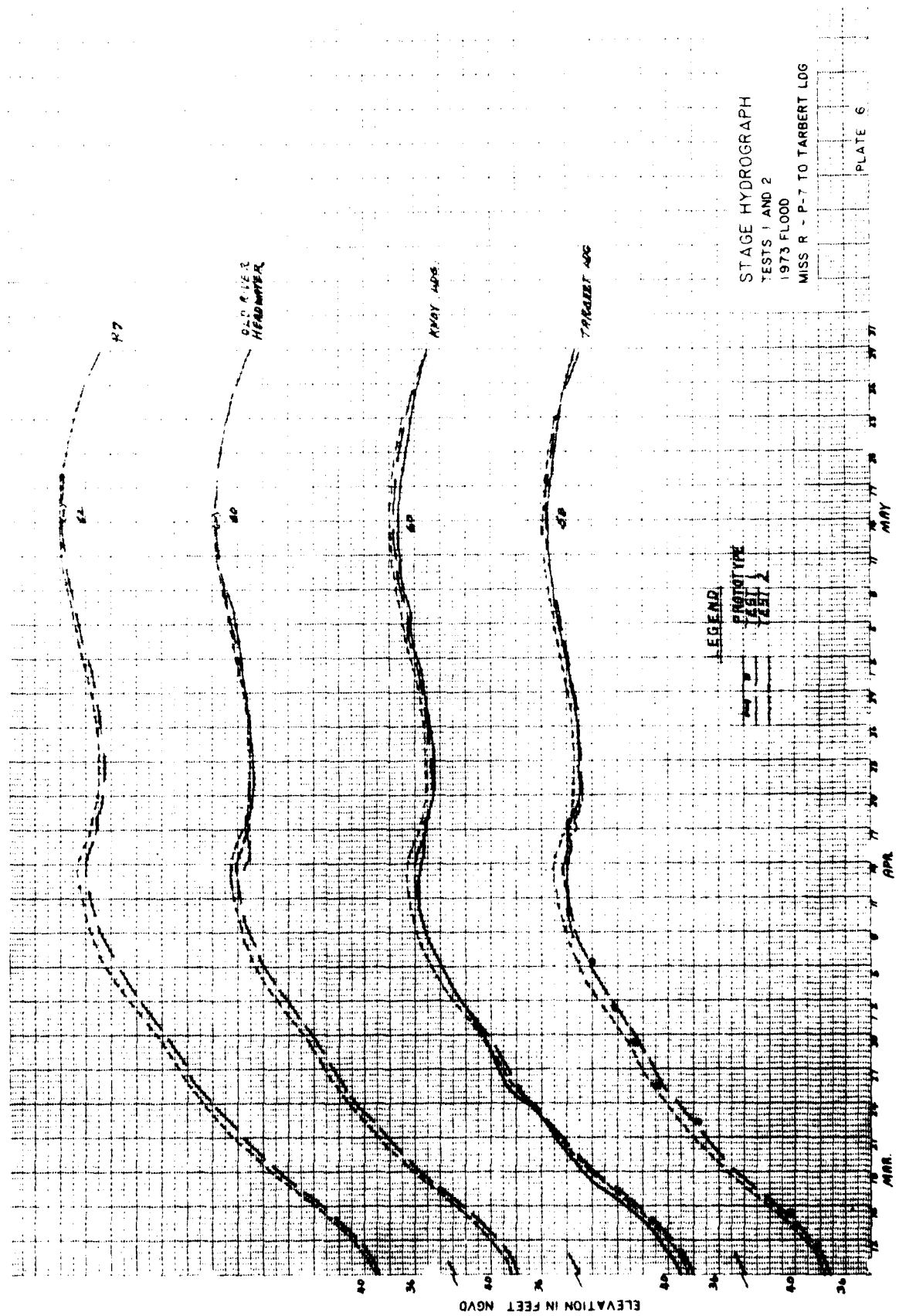












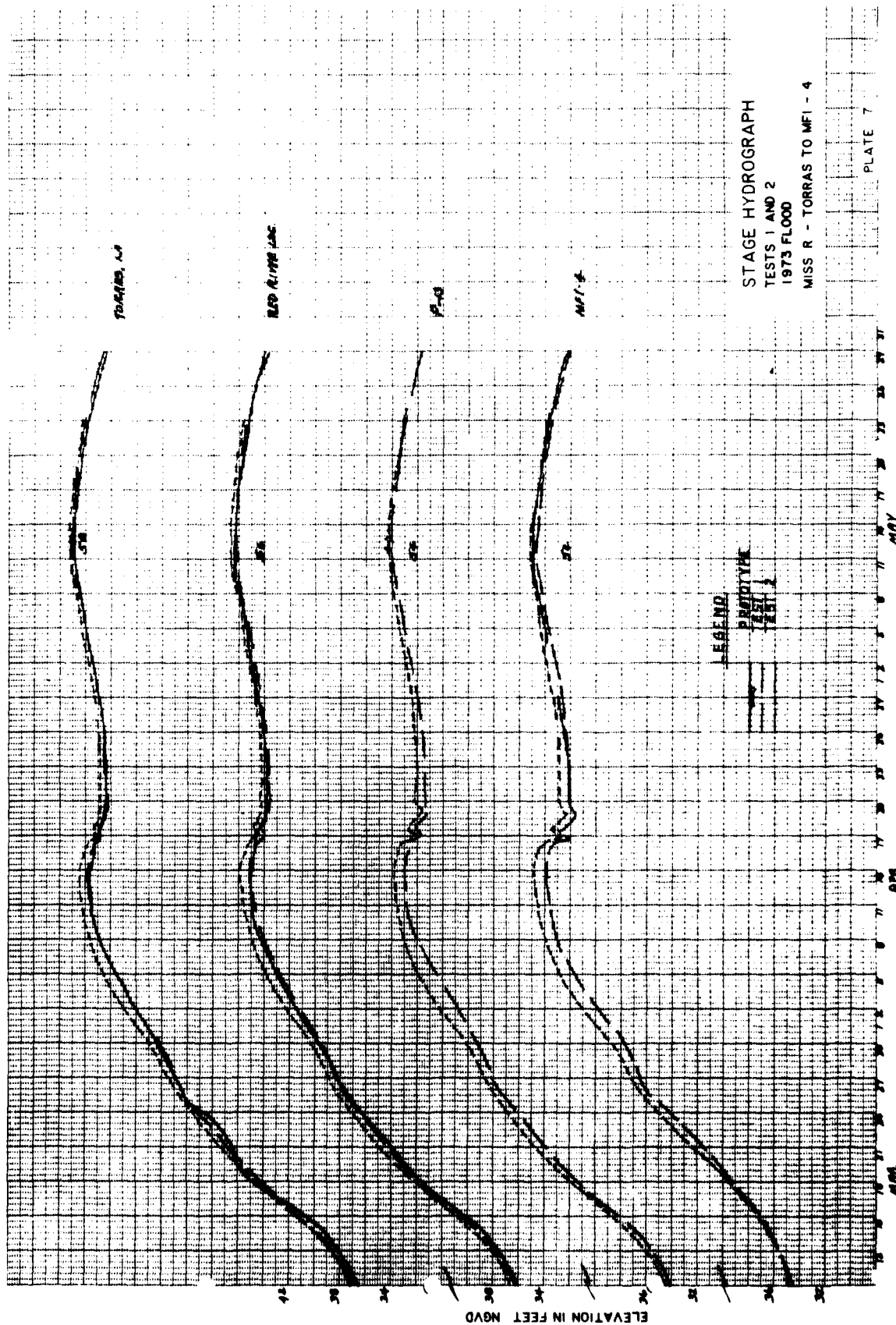
STAGE HYDROGRAPH

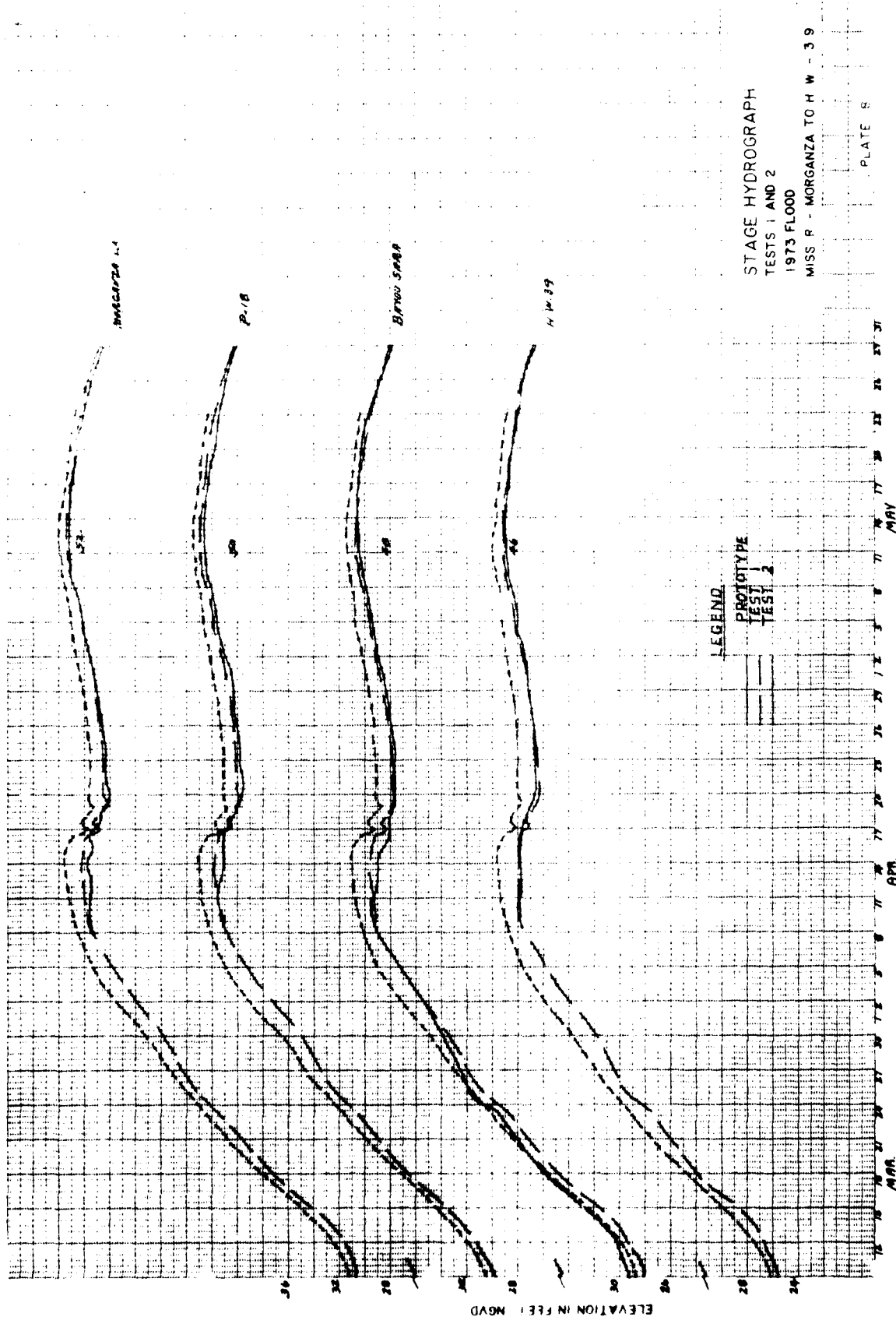
TESTS 1 AND 2

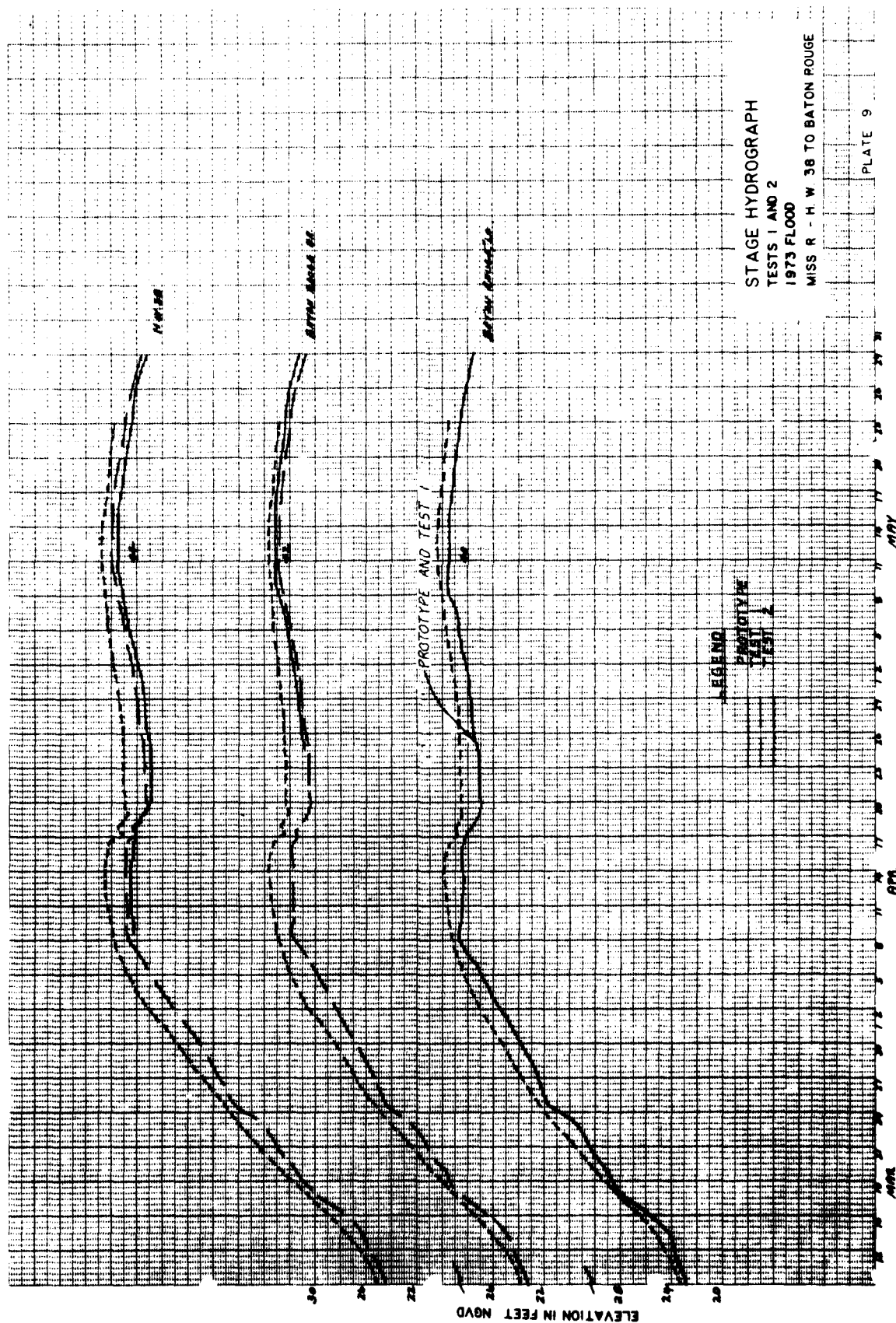
1973 FLOOD

MISS R - P-7 TO TARBERT LOG

PLATE 6





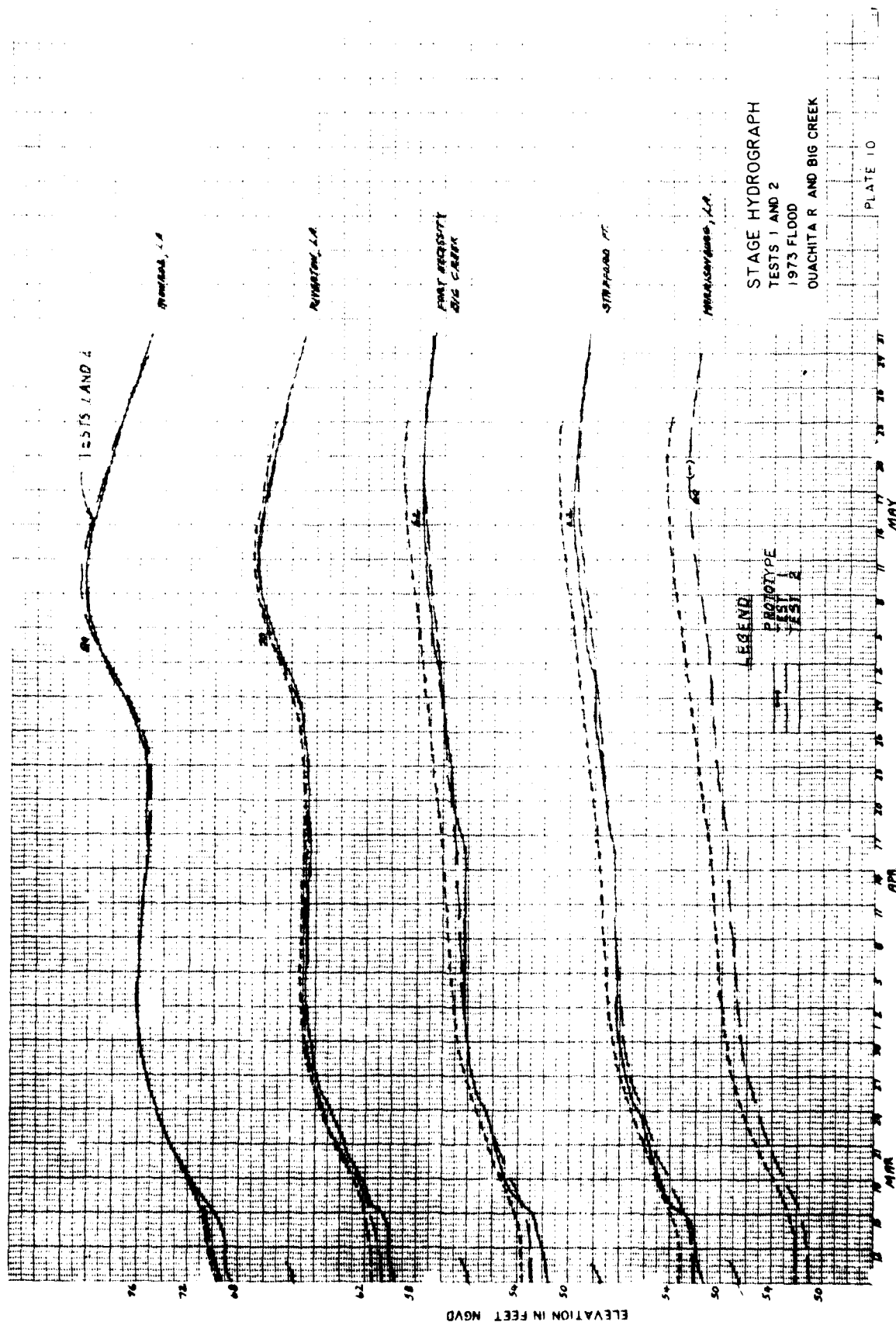


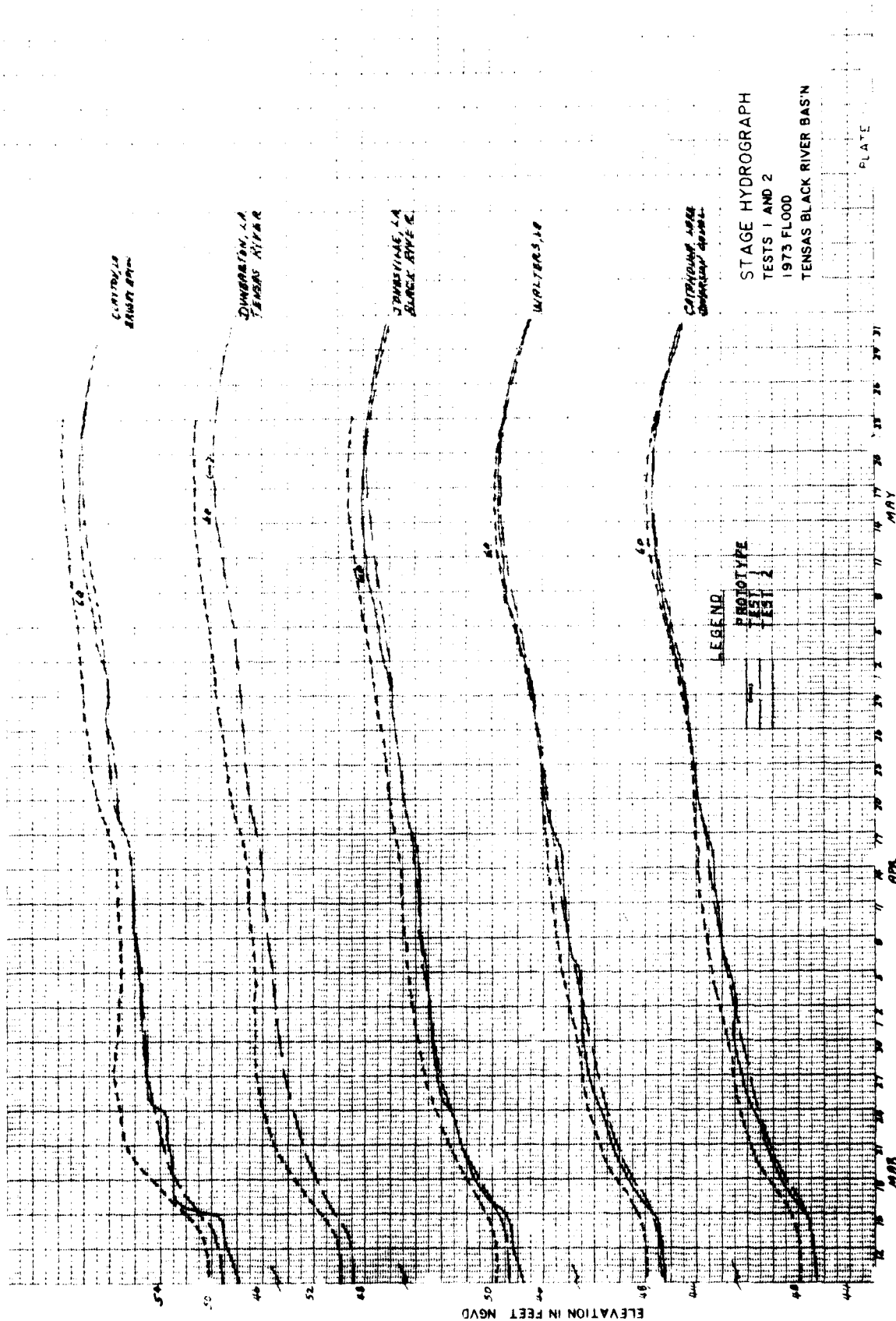
STAGE HYDROGRAPH

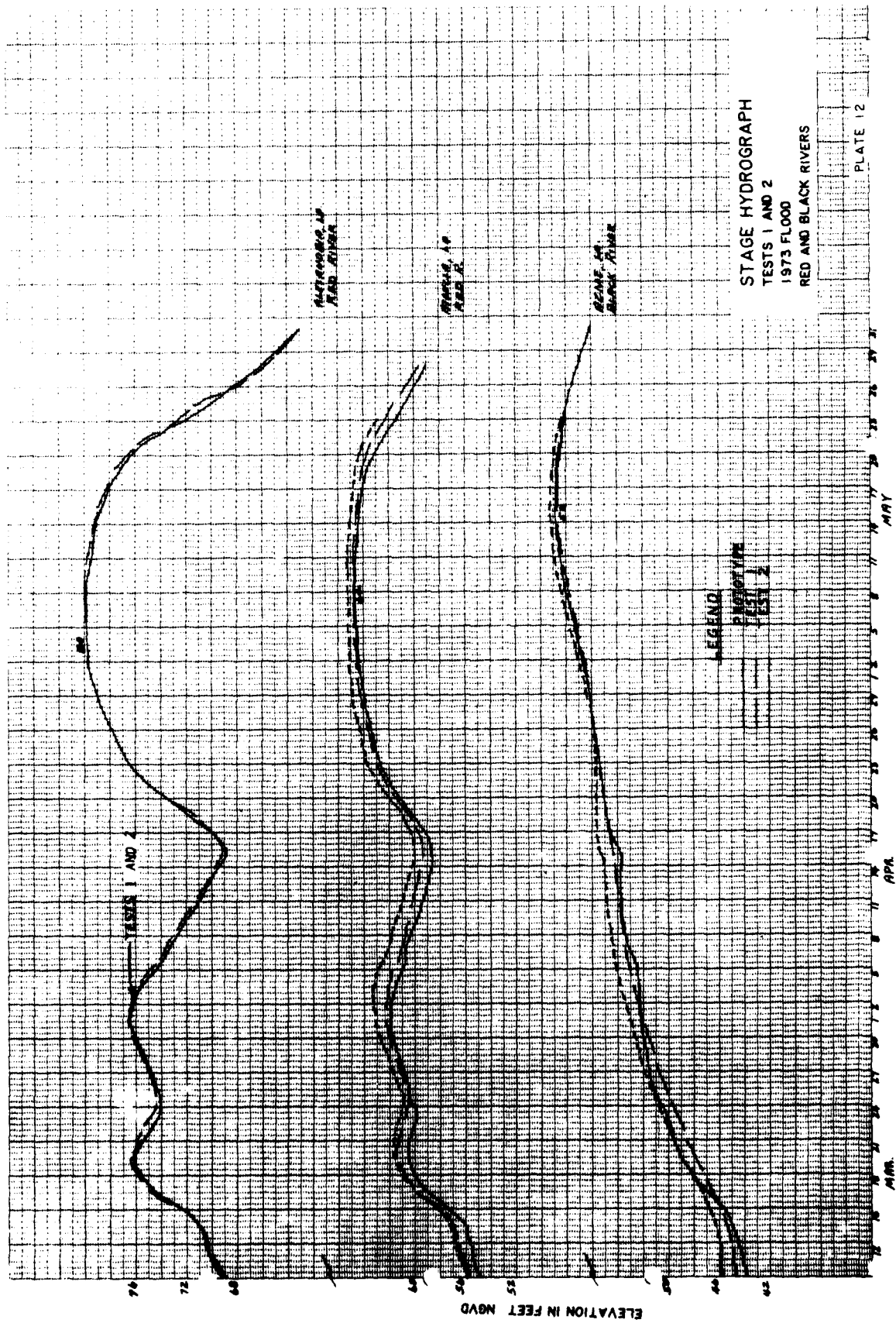
TESTS 1 AND 2
1973 FLOOD

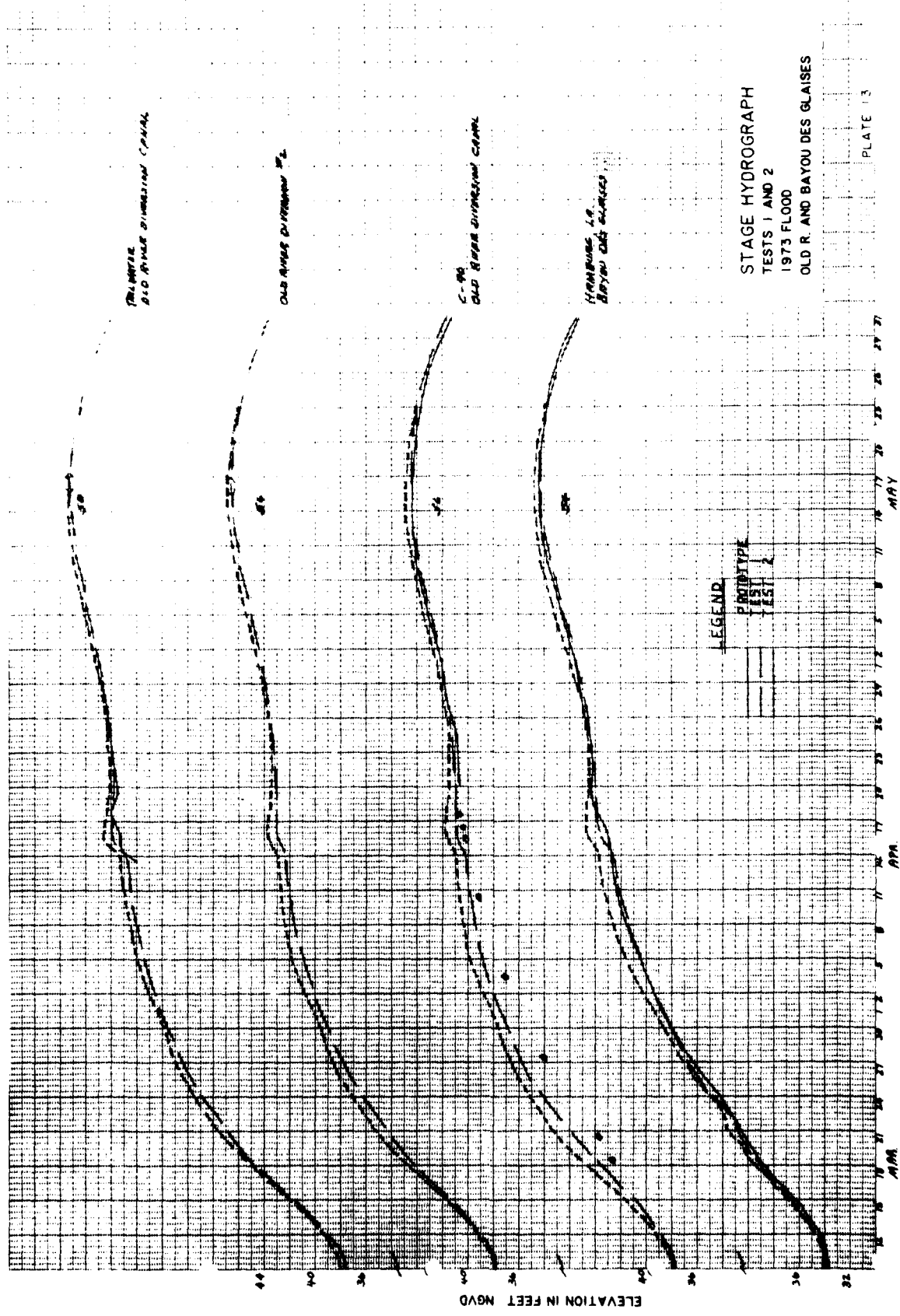
MISS R - H W 38 TO BATON ROUGE

PLATE 9

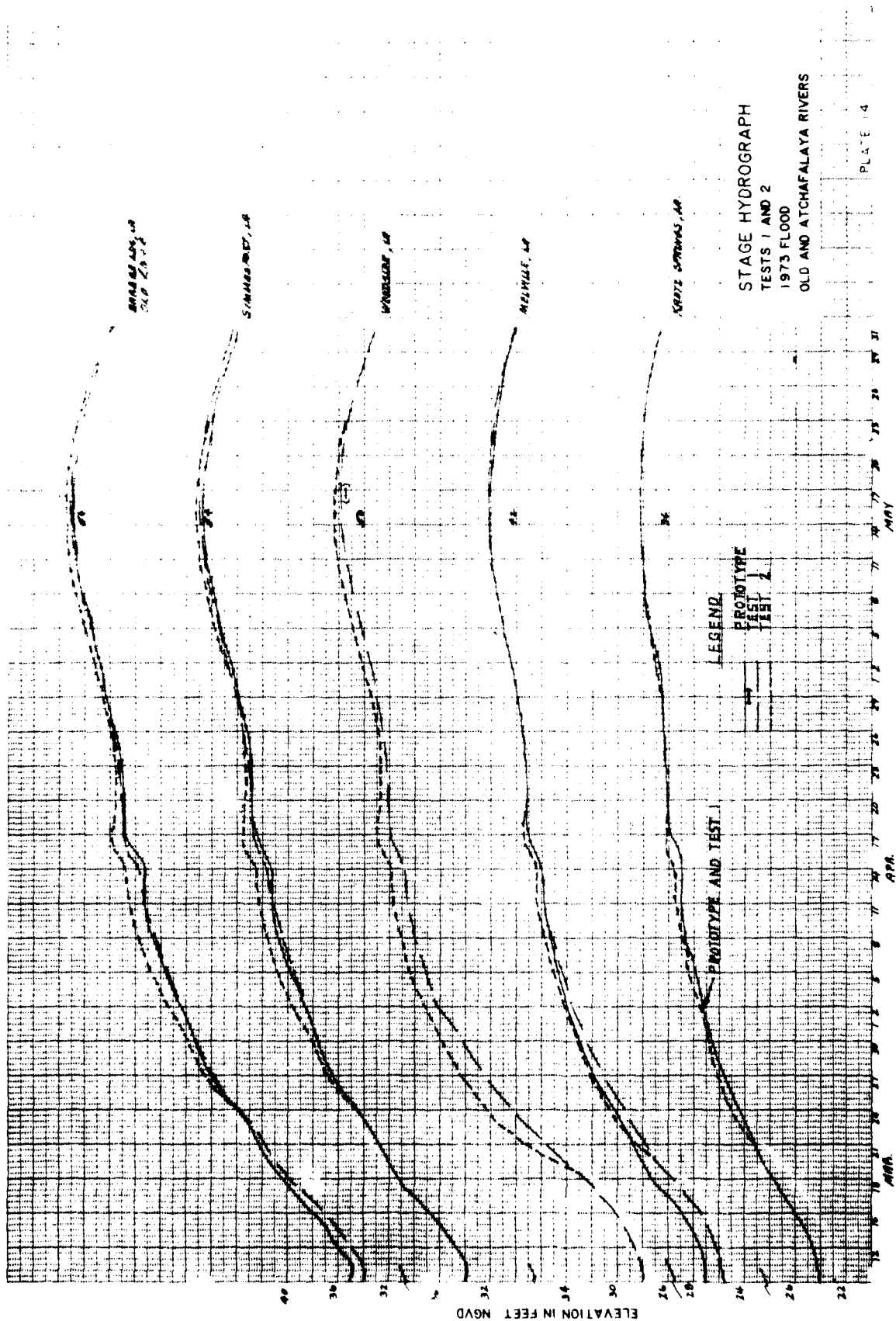


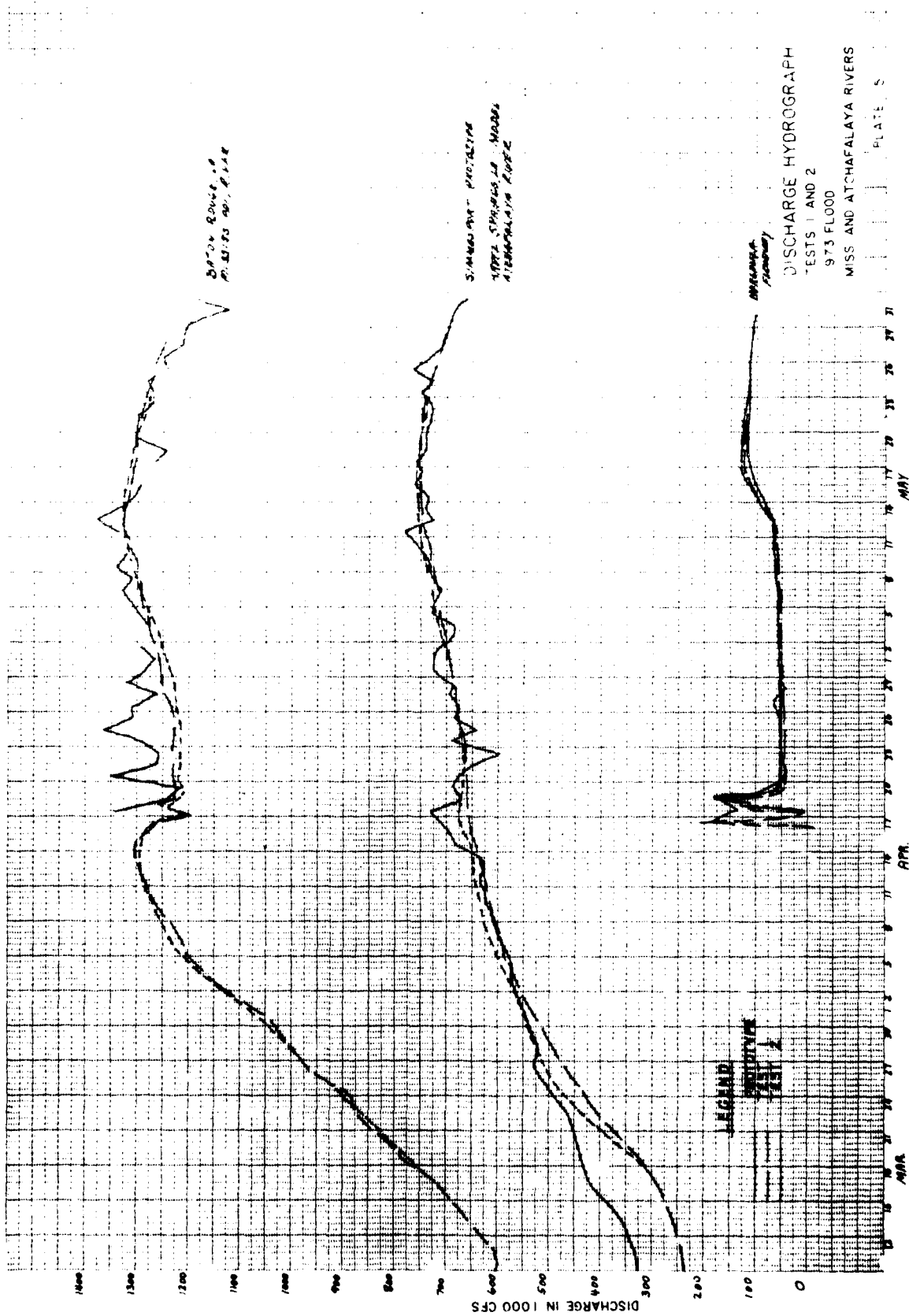


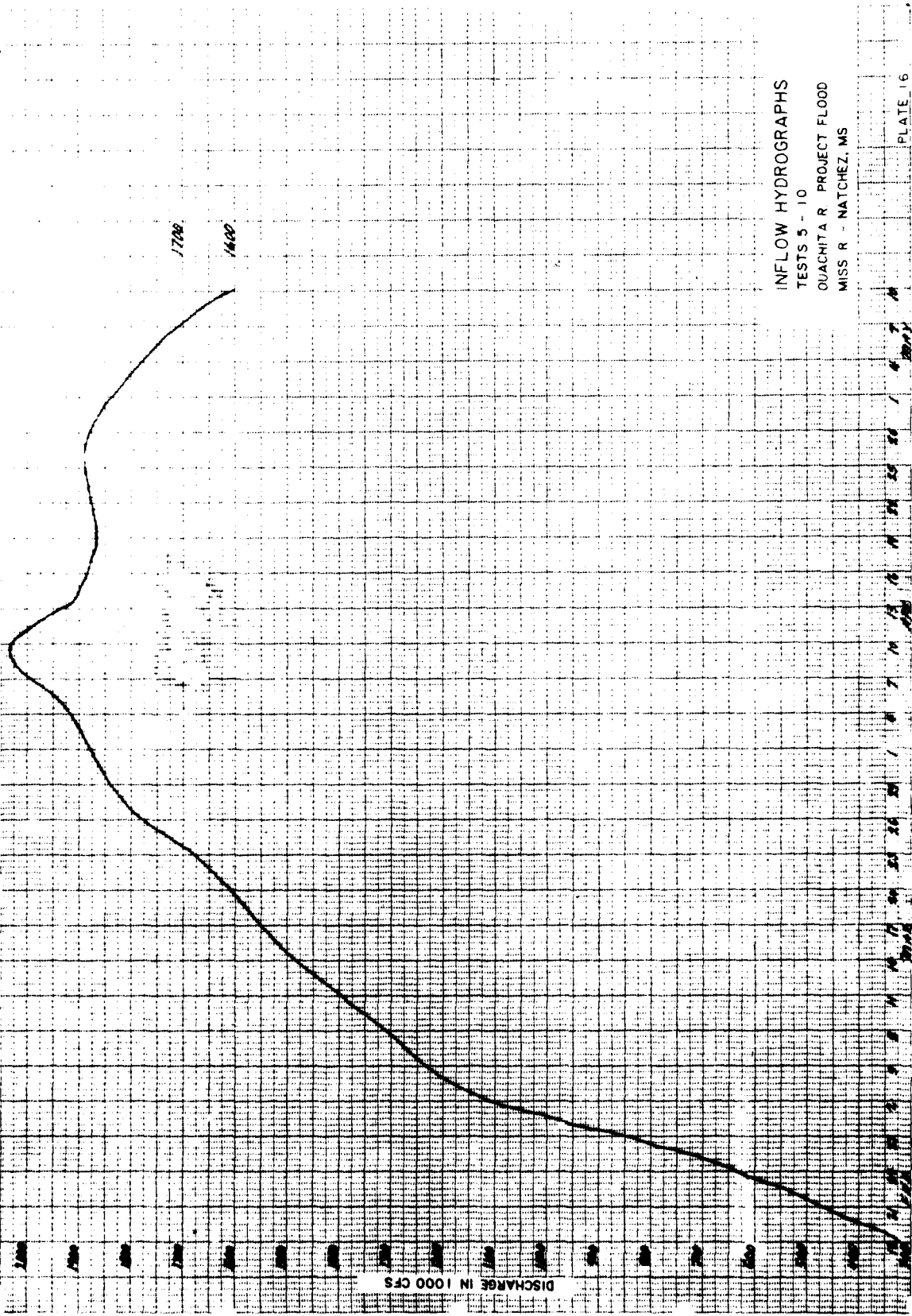




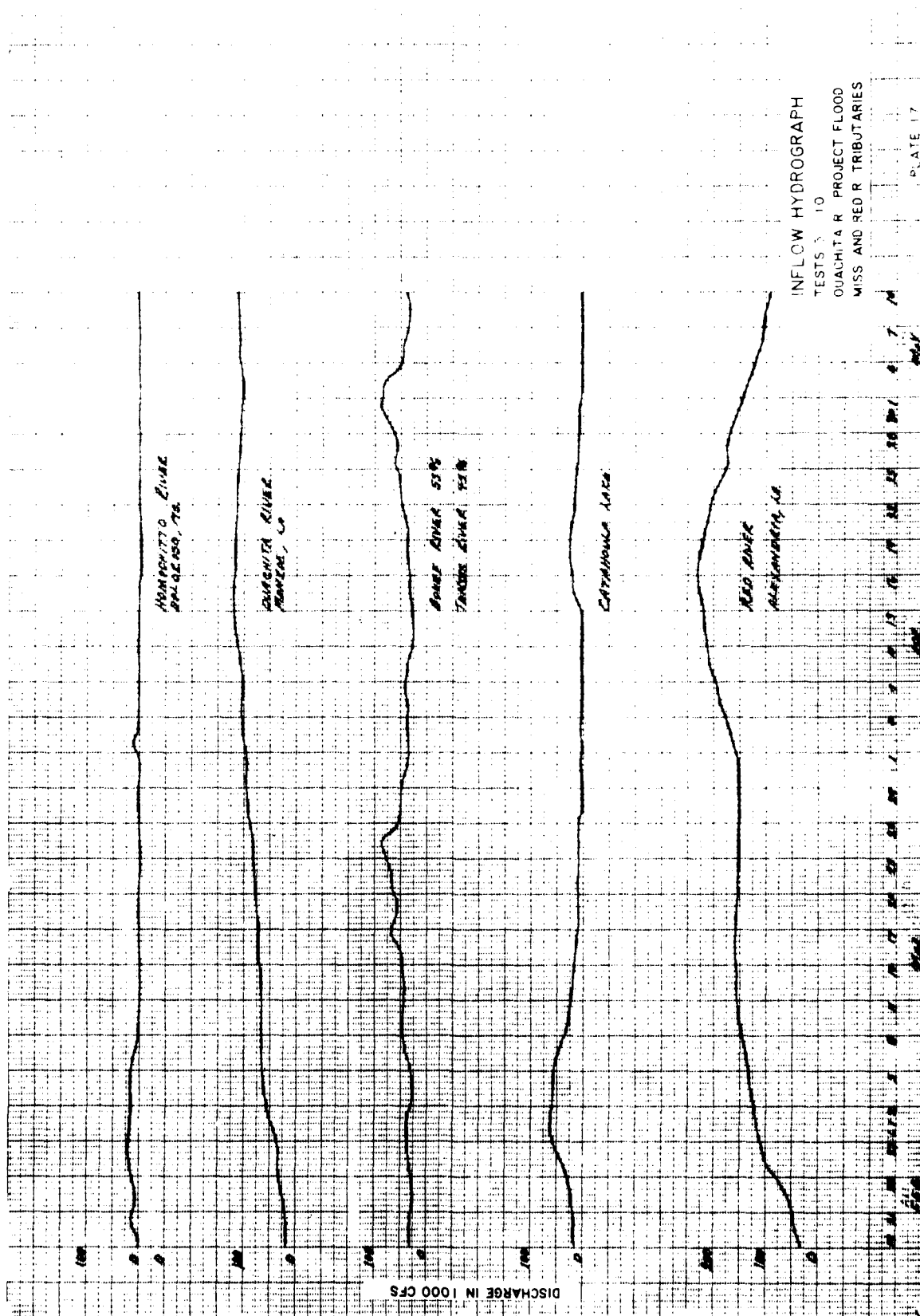
STAGE HYDROGRAPH
 TESTS 1 AND 2
 1973 FLOOD
 OLD R. AND BAYOU DES GLAISES

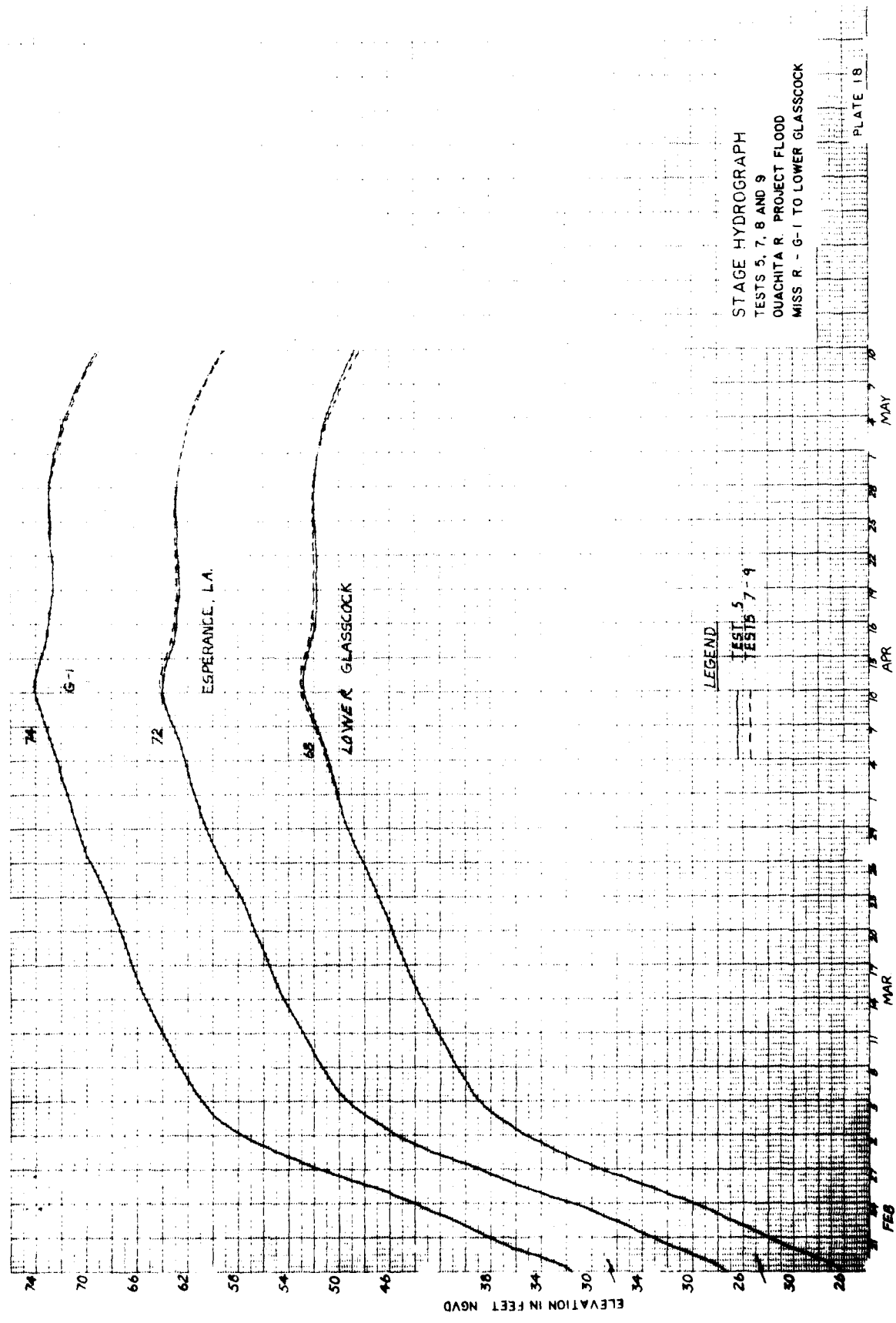


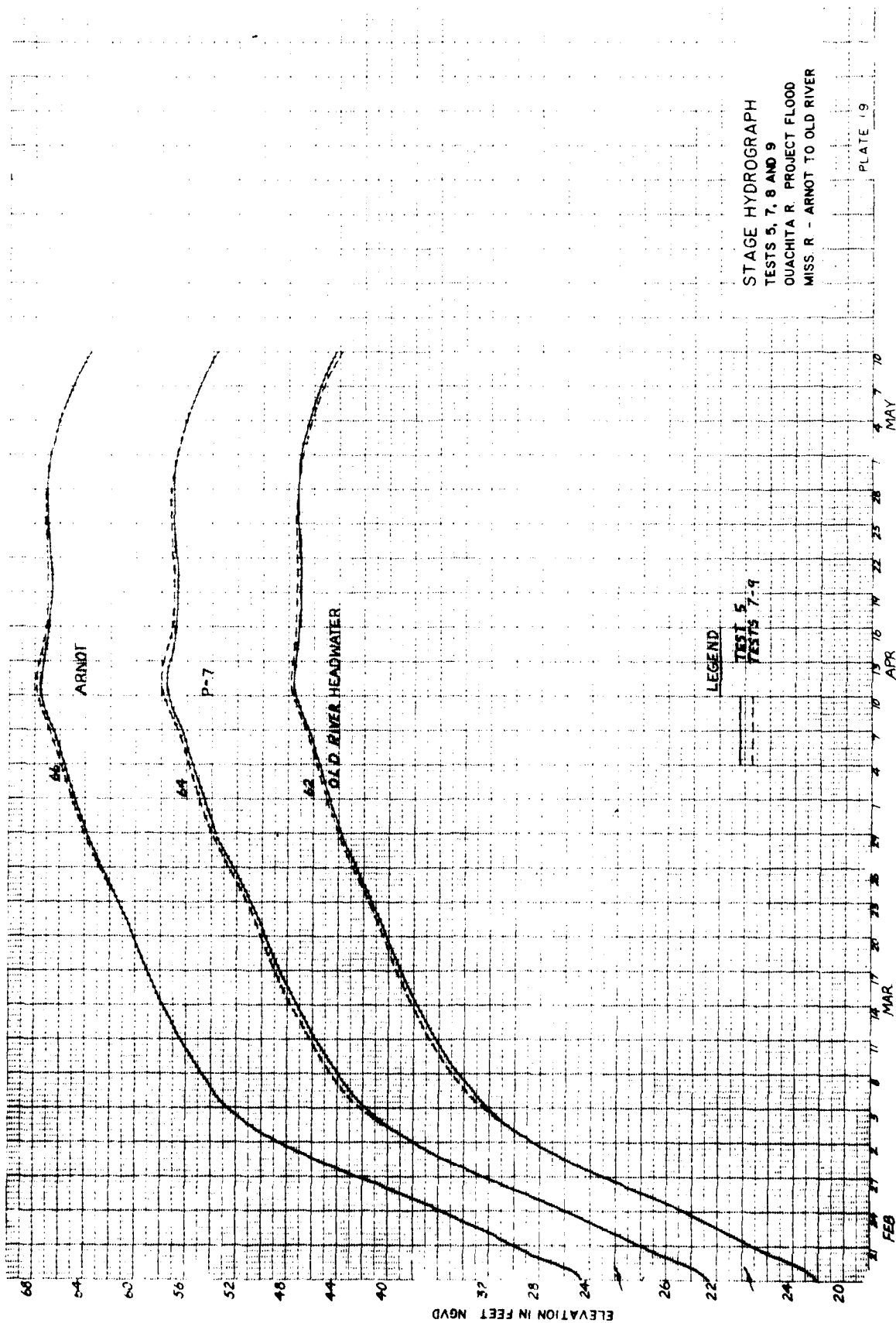




INFLOW HYDROGRAPHS
TESTS 5 - 10
QUACHITA R PROJECT FLOOD
MISS R - NATCHEZ, MS

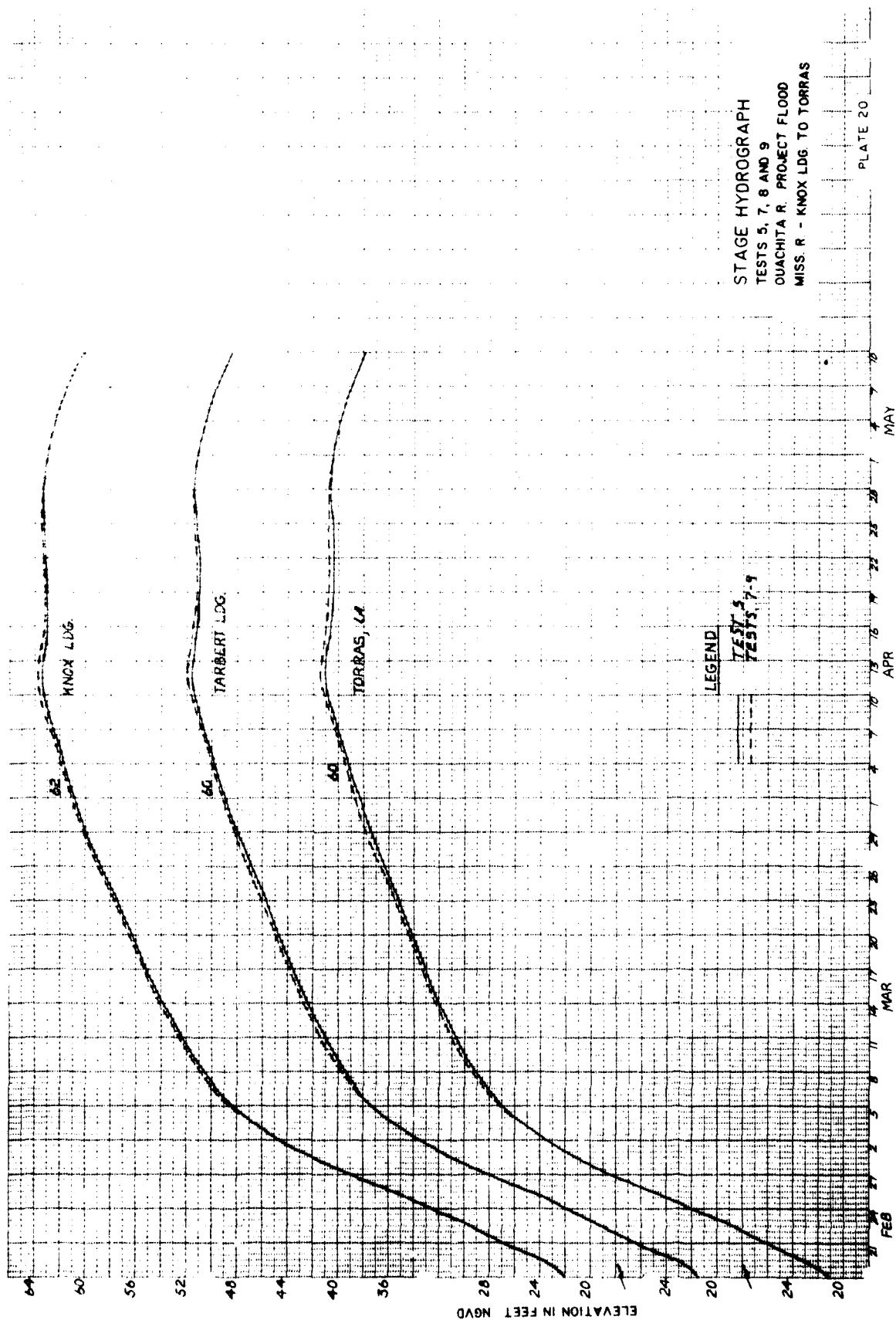


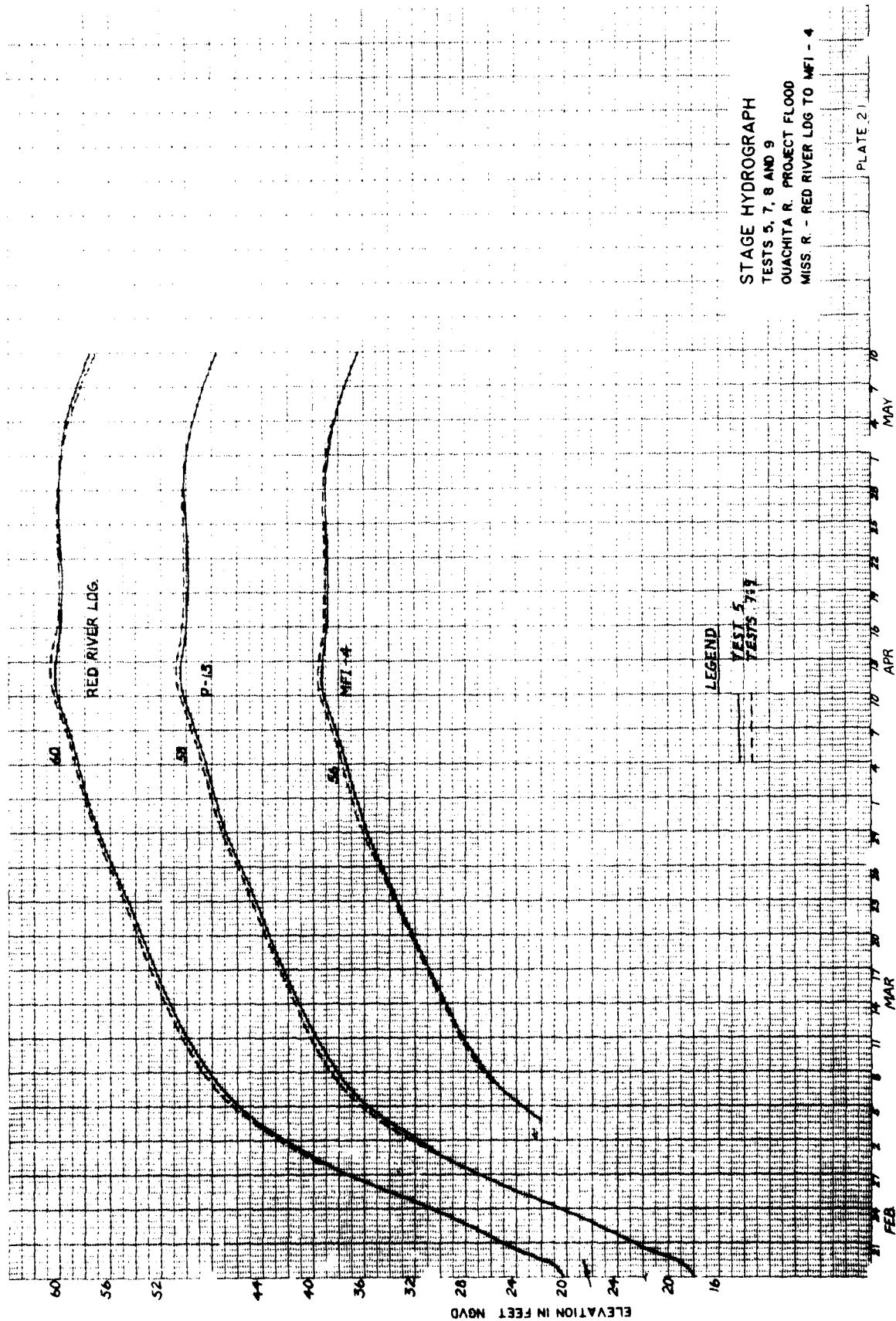


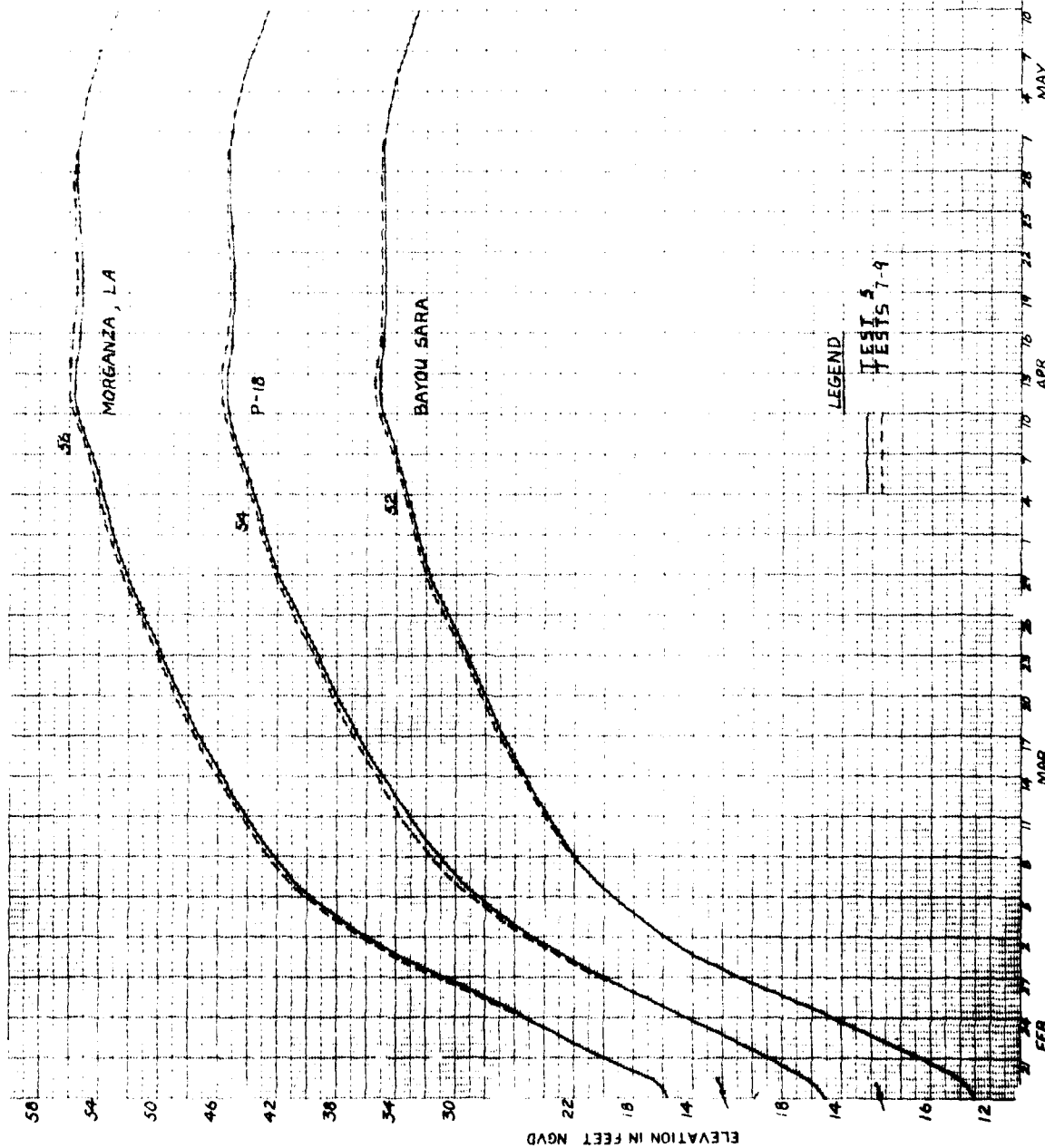


STAGE HYDROGRAPH
TESTS 5, 7, 8 AND 9
OUACHITA R. PROJECT FLOOD
MISS R - ARNOT TO OLD RIVER

PLATE 19

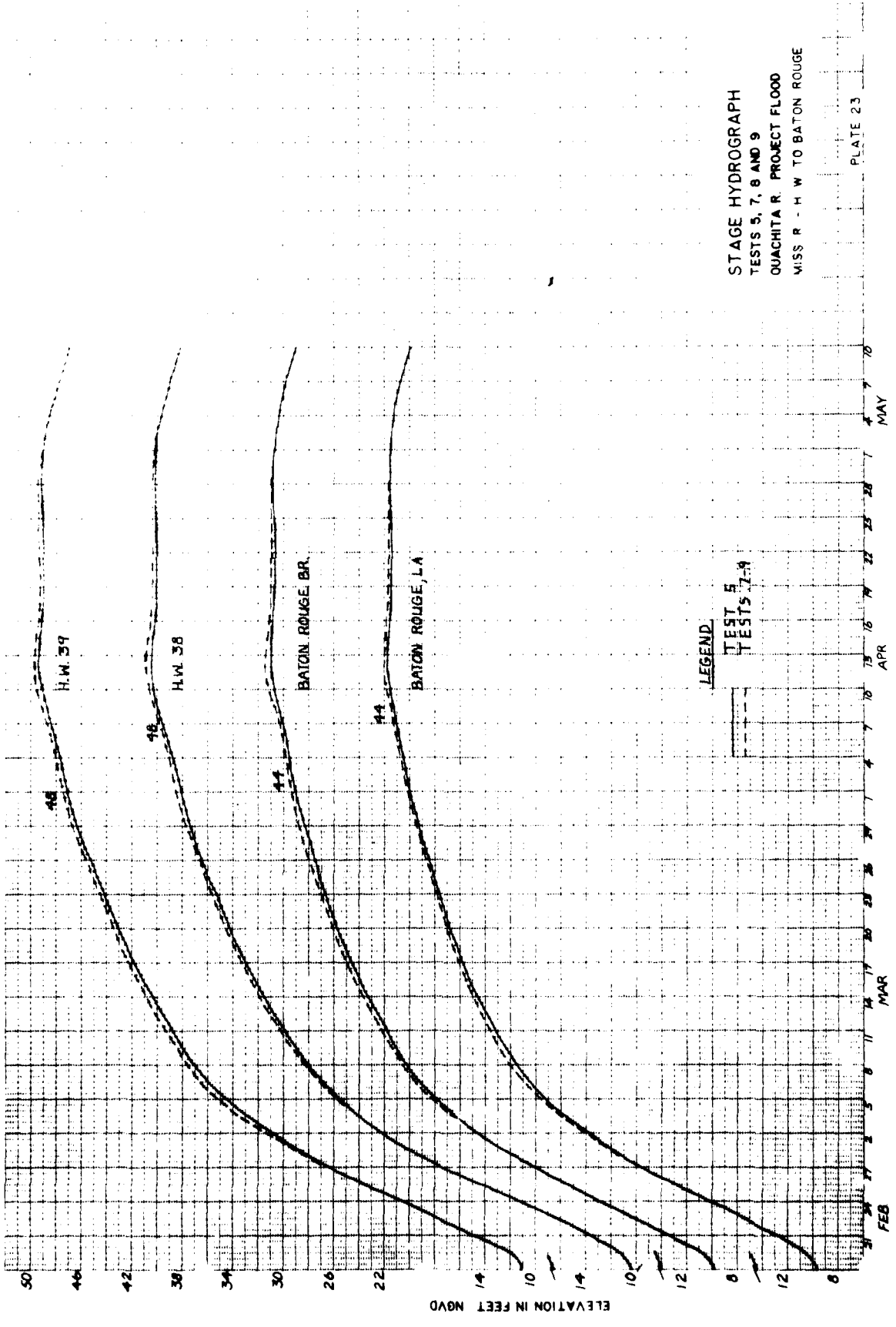






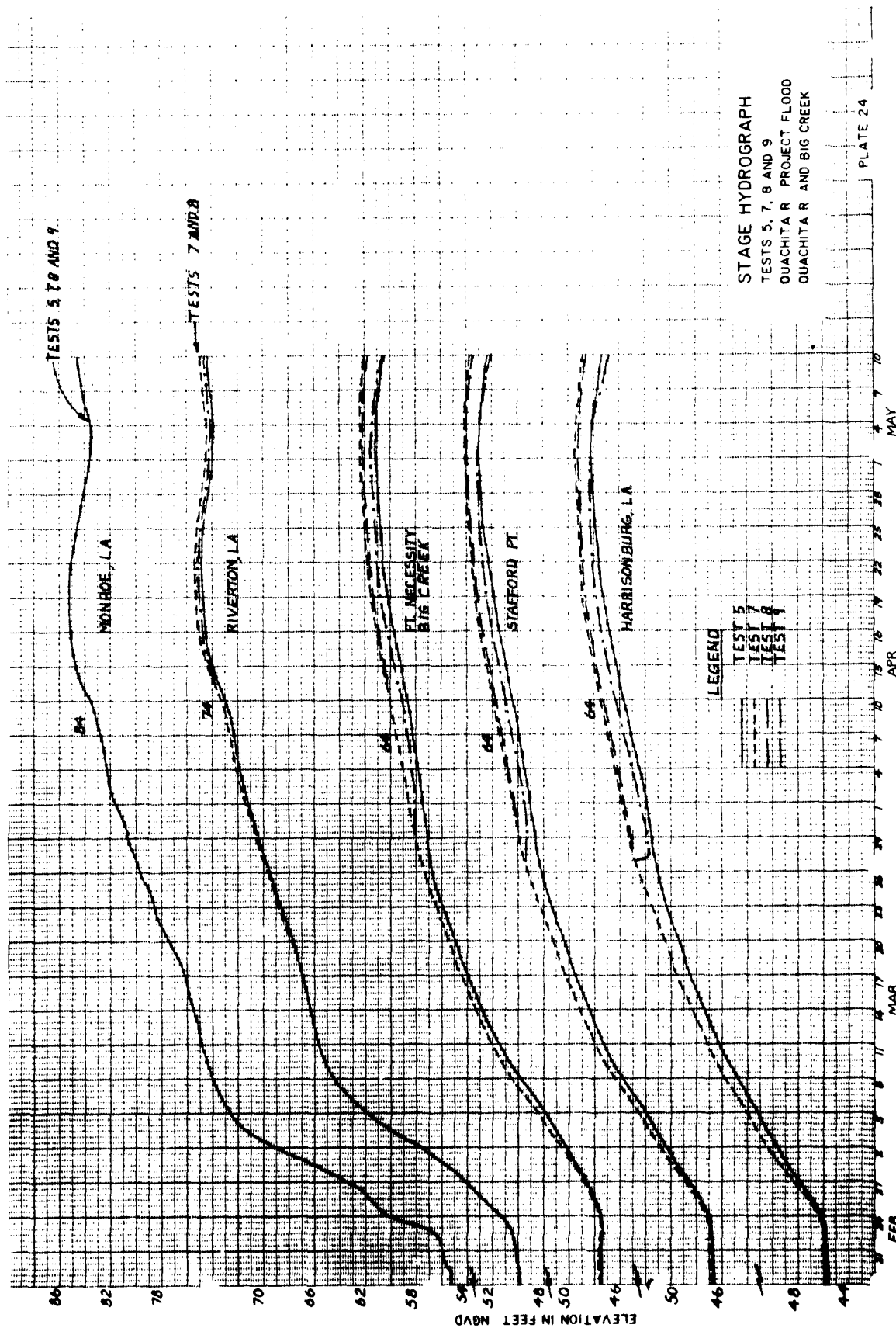
STAGE HYDROGRAPH
 TESTS 5, 7, 8 AND 9
 OUACHITA R. PROJECT FLOOD
 MISS. R. - MORGANZA TO BAYOU SARA

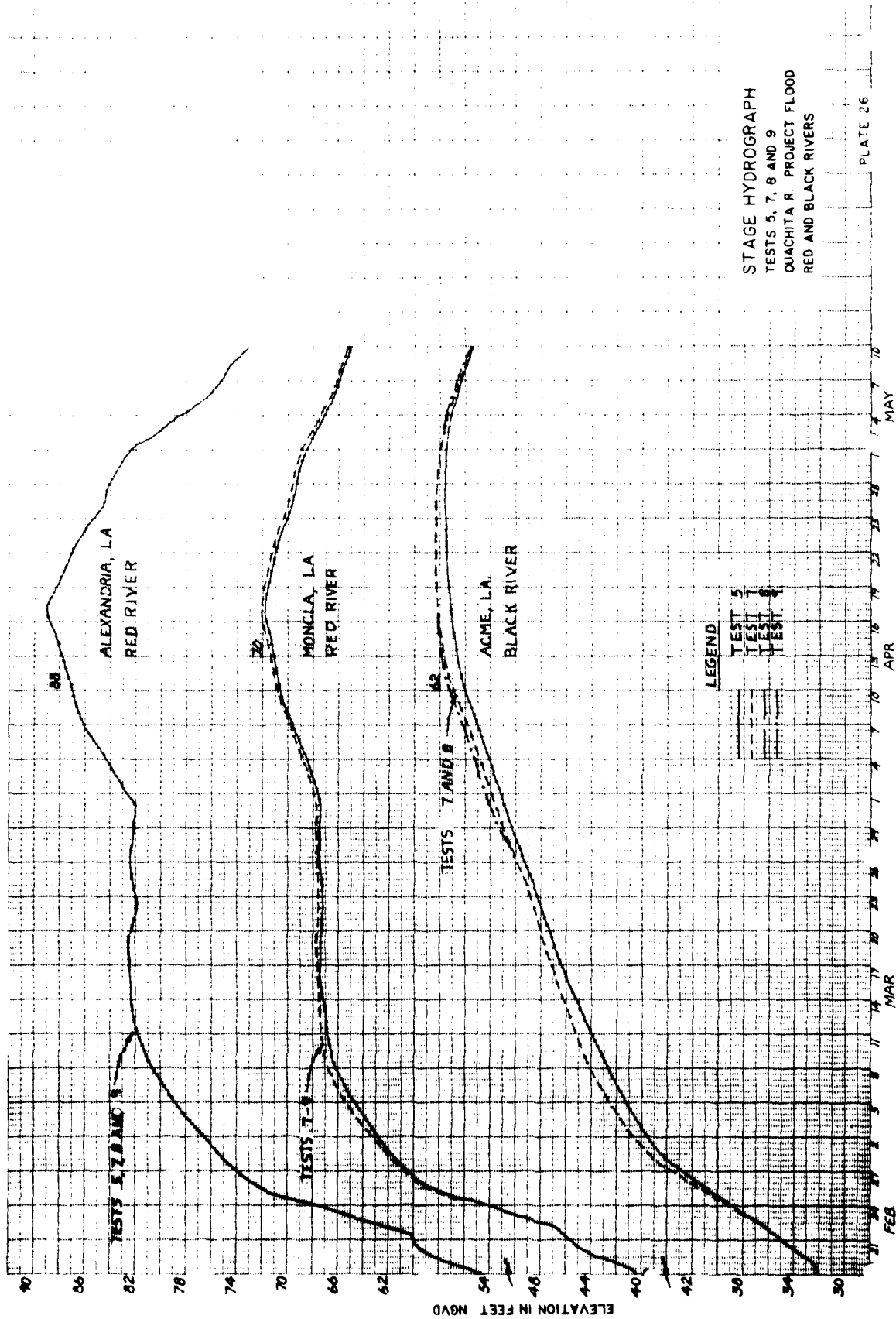
PLATE 22

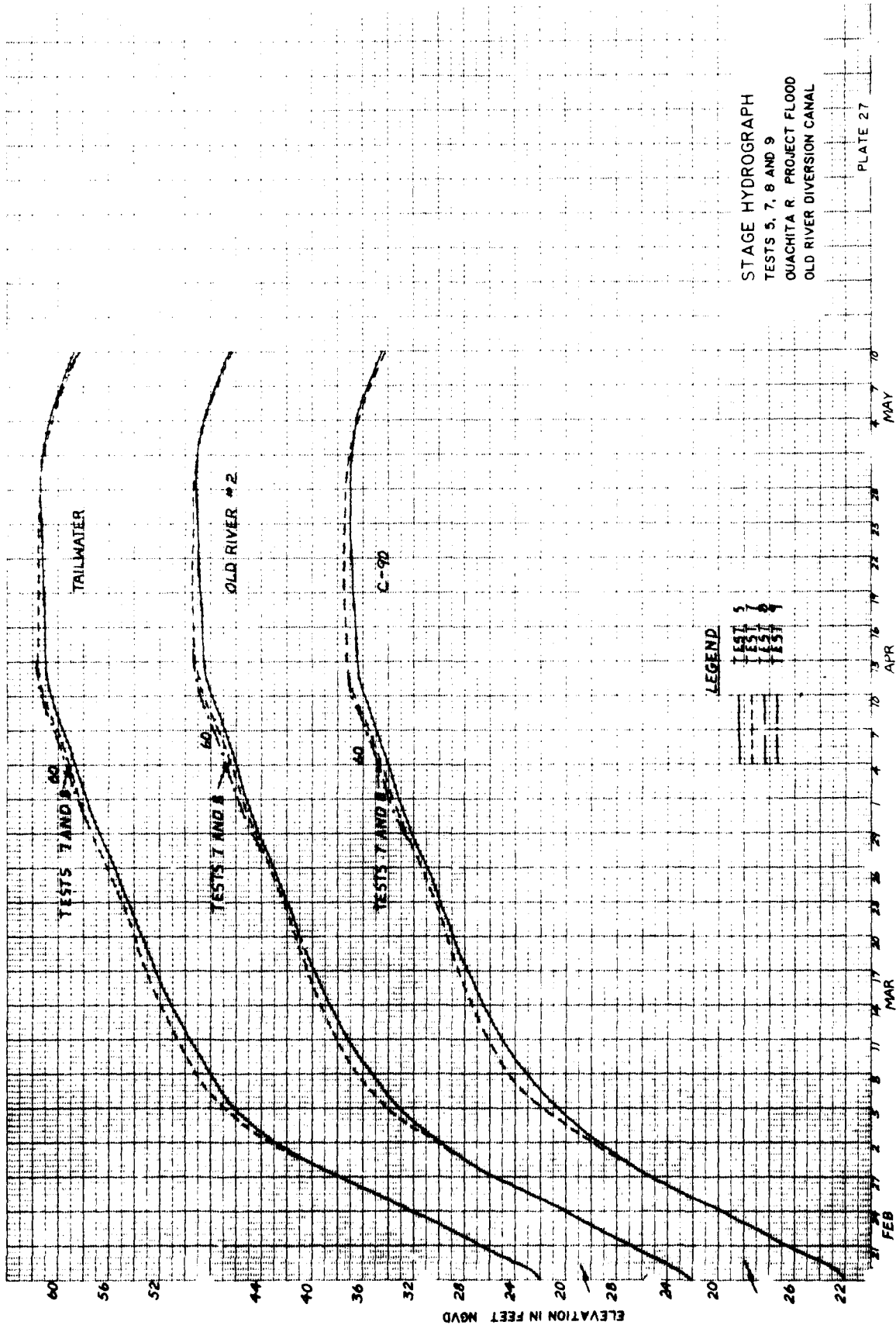


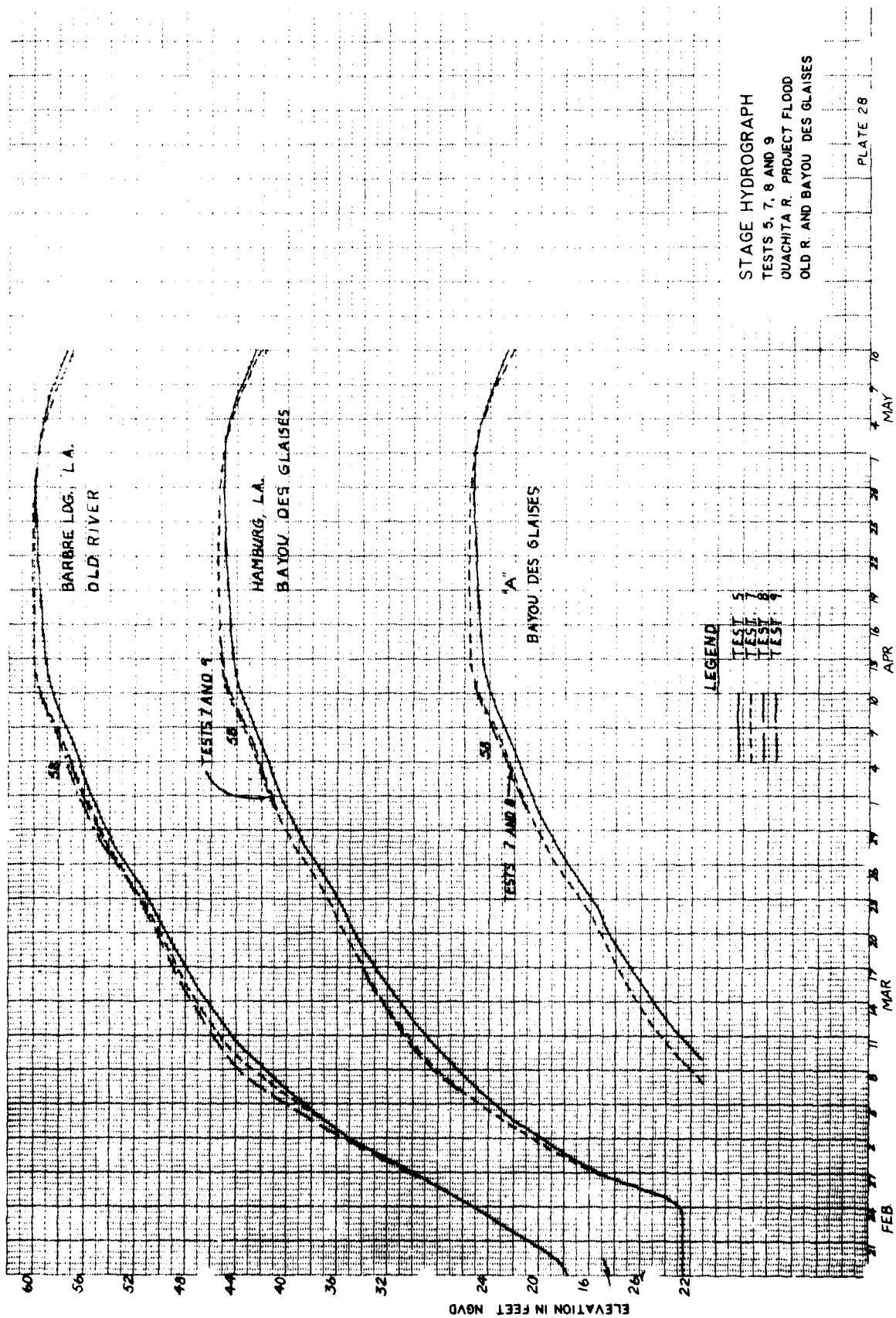
STAGE HYDROGRAPH
TESTS 5, 7, 8 AND 9
QUACHITA R. PROJECT FLOOD
MISS R - H W TO BATON ROUGE

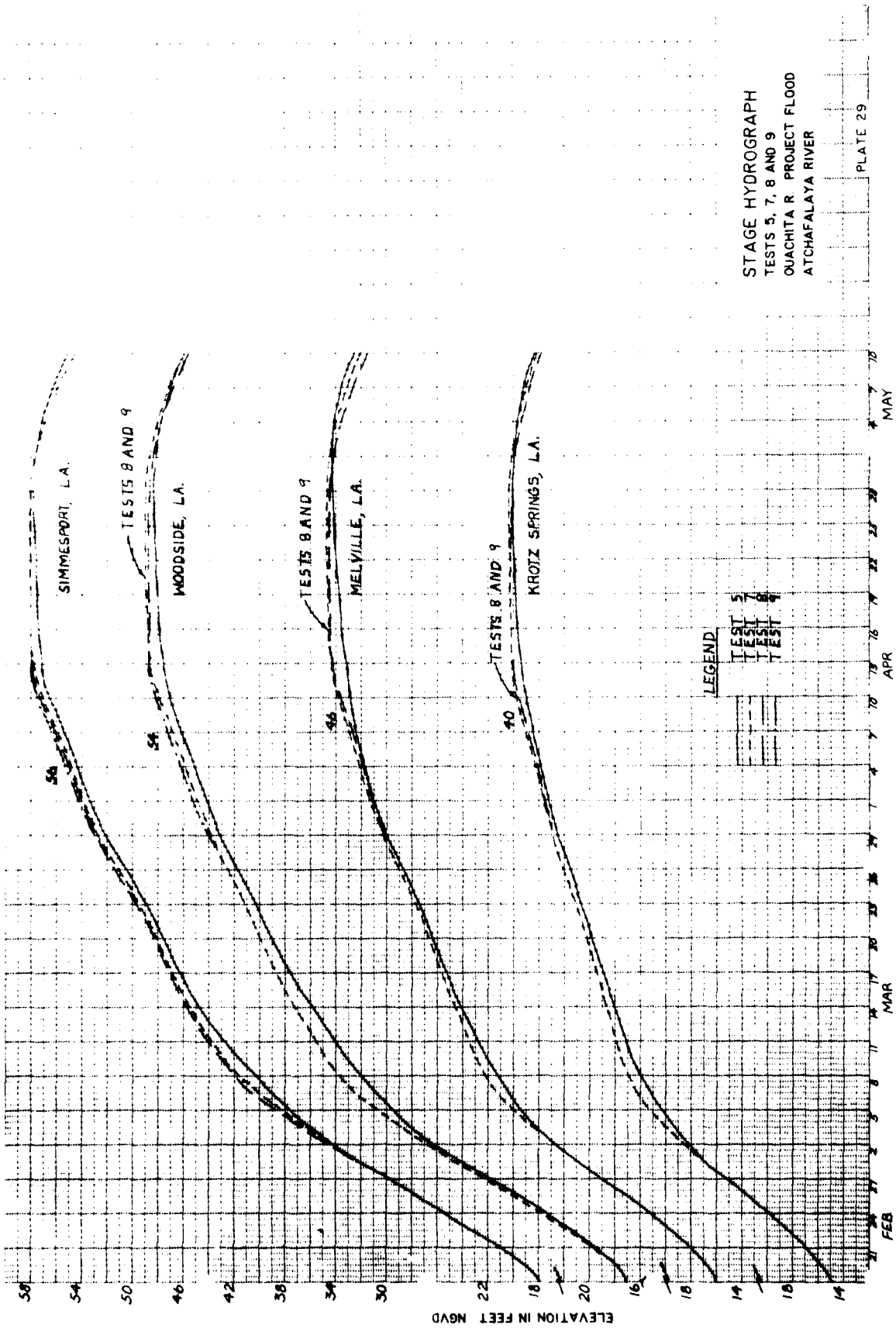
PLATE 23

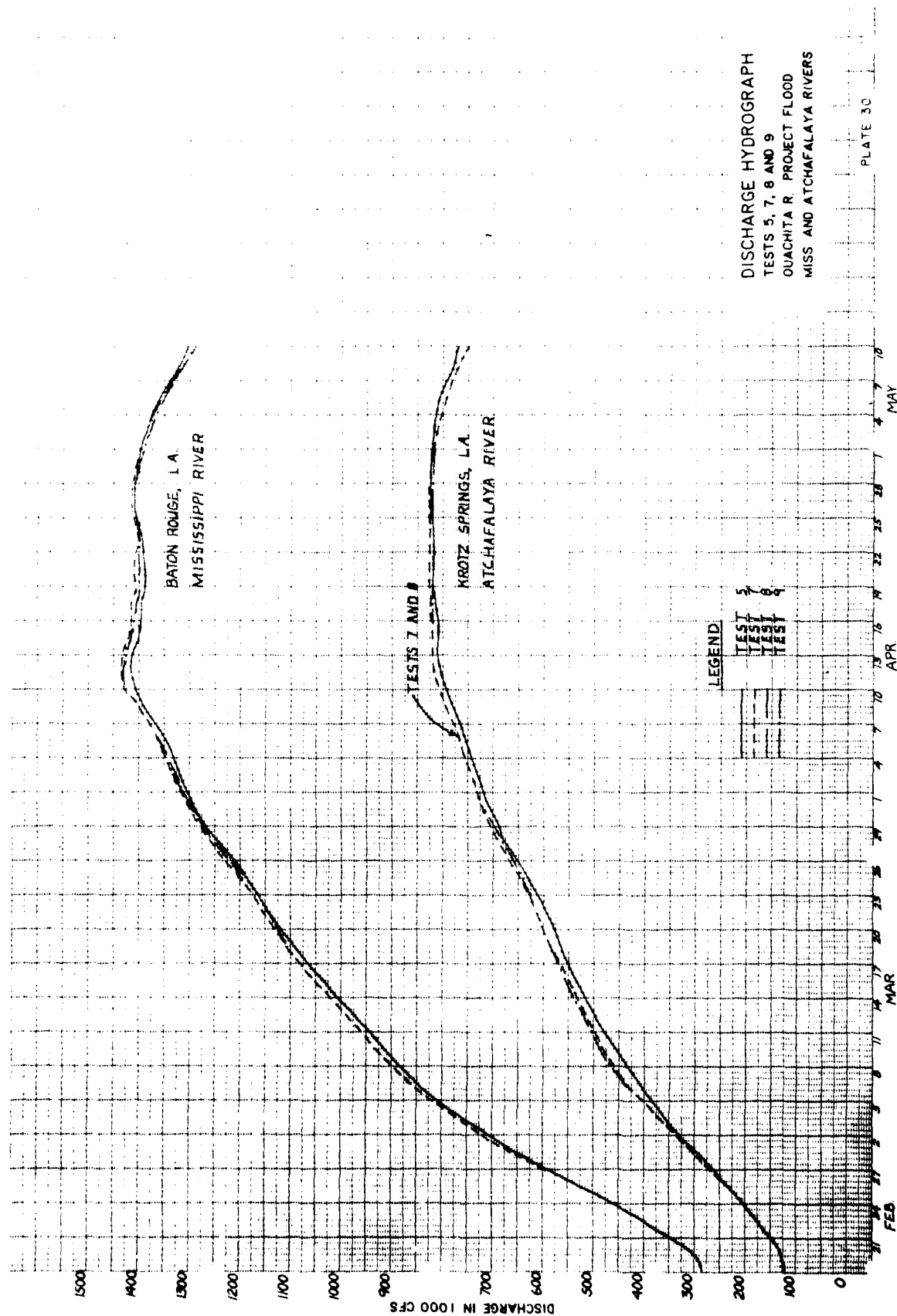


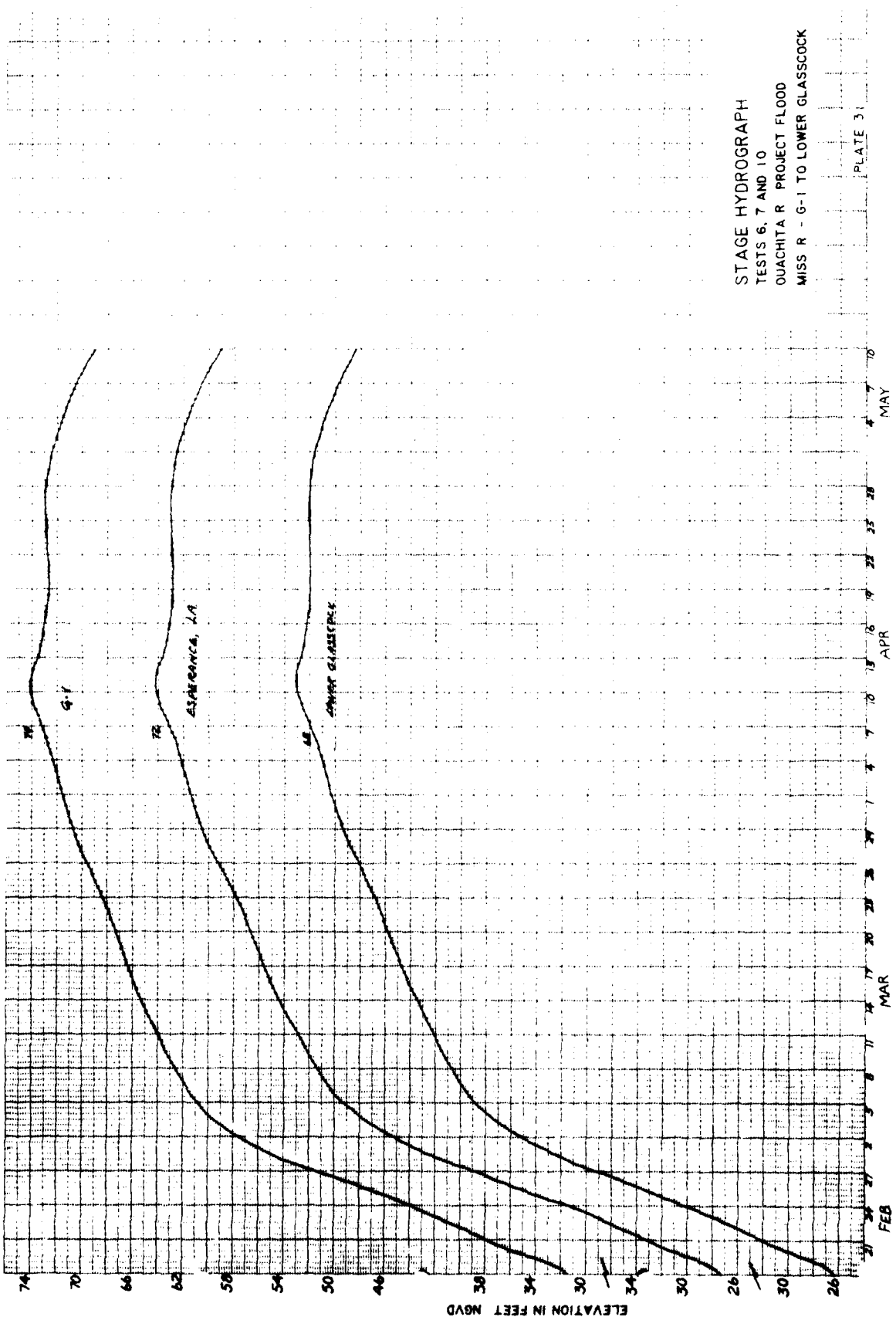






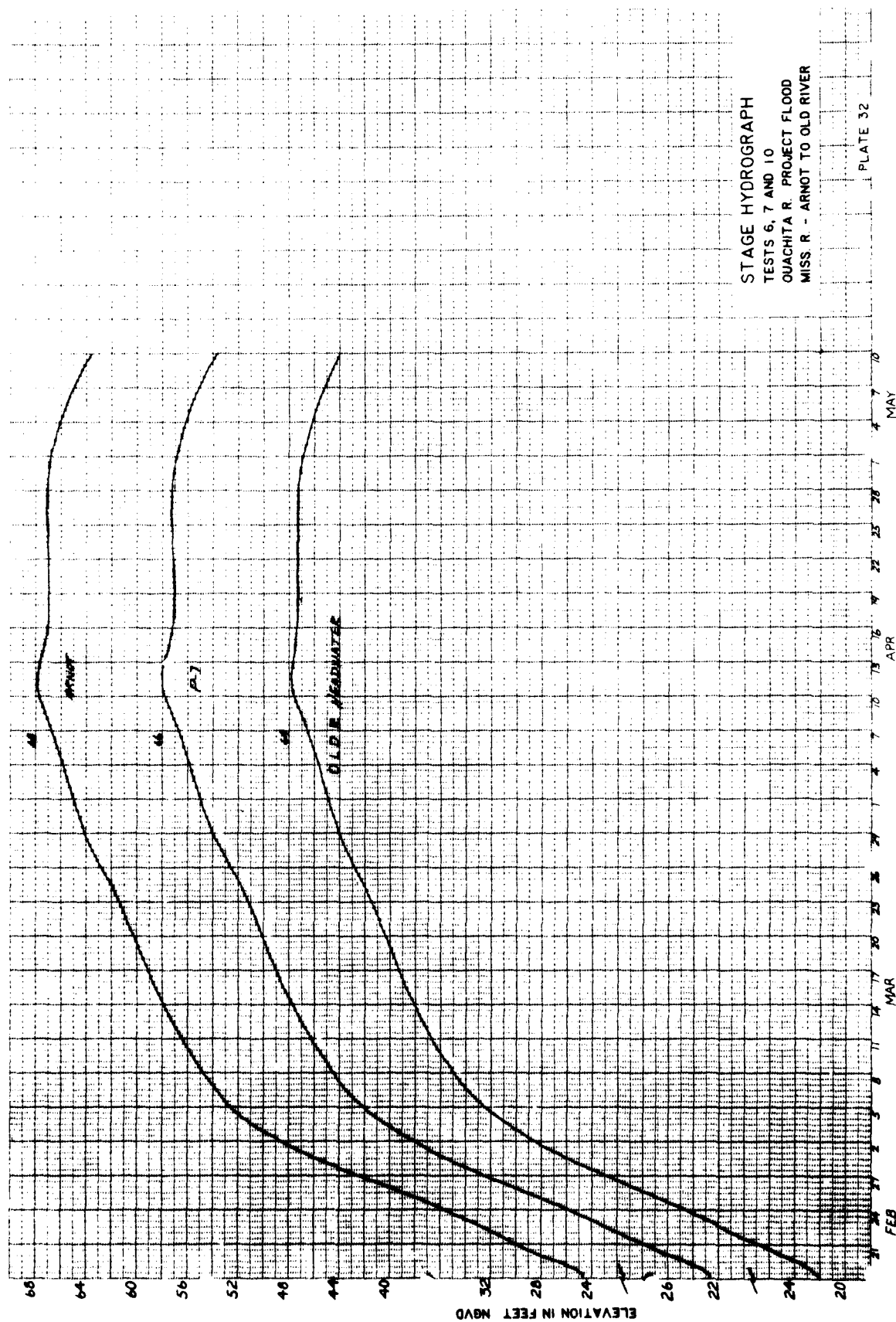


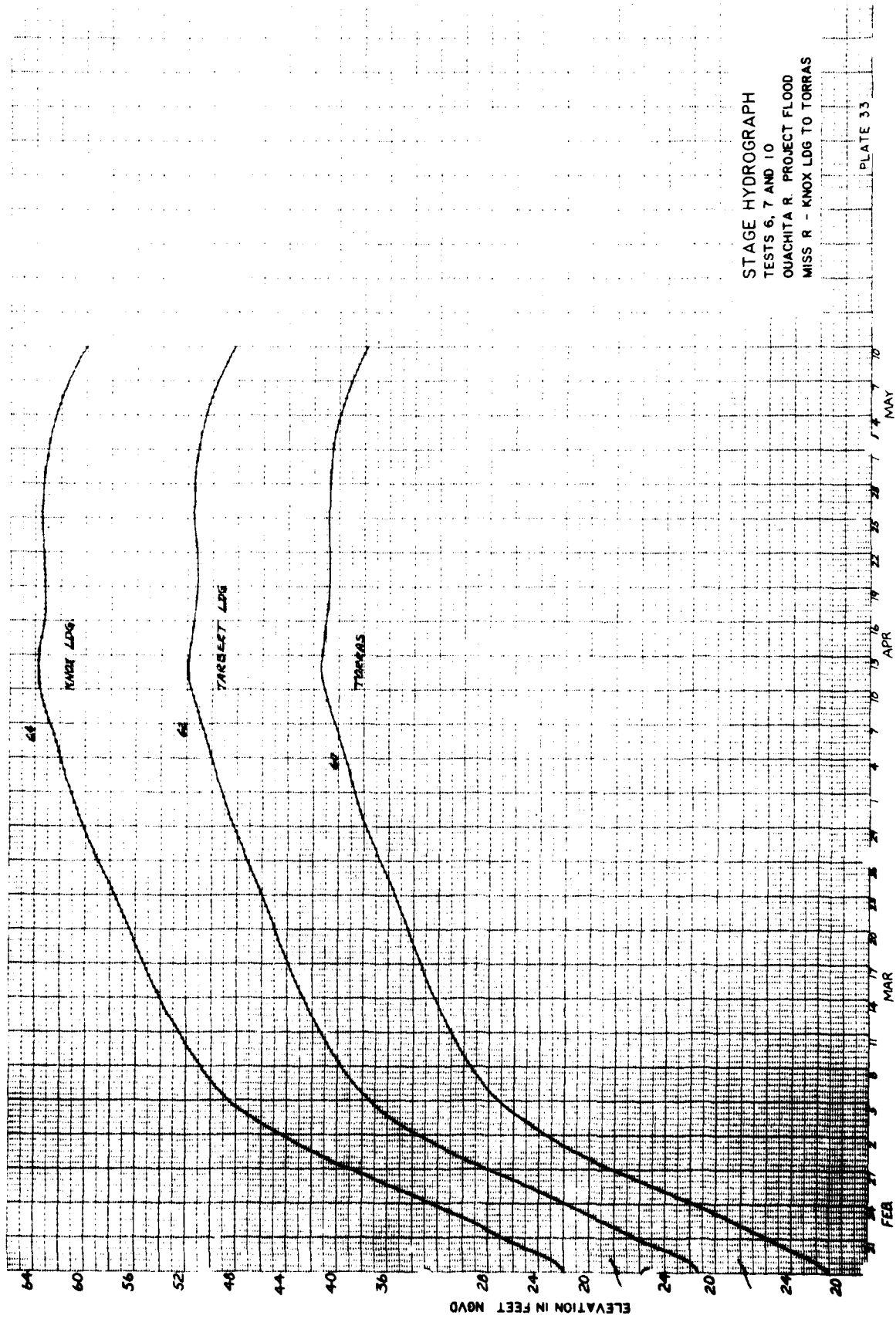




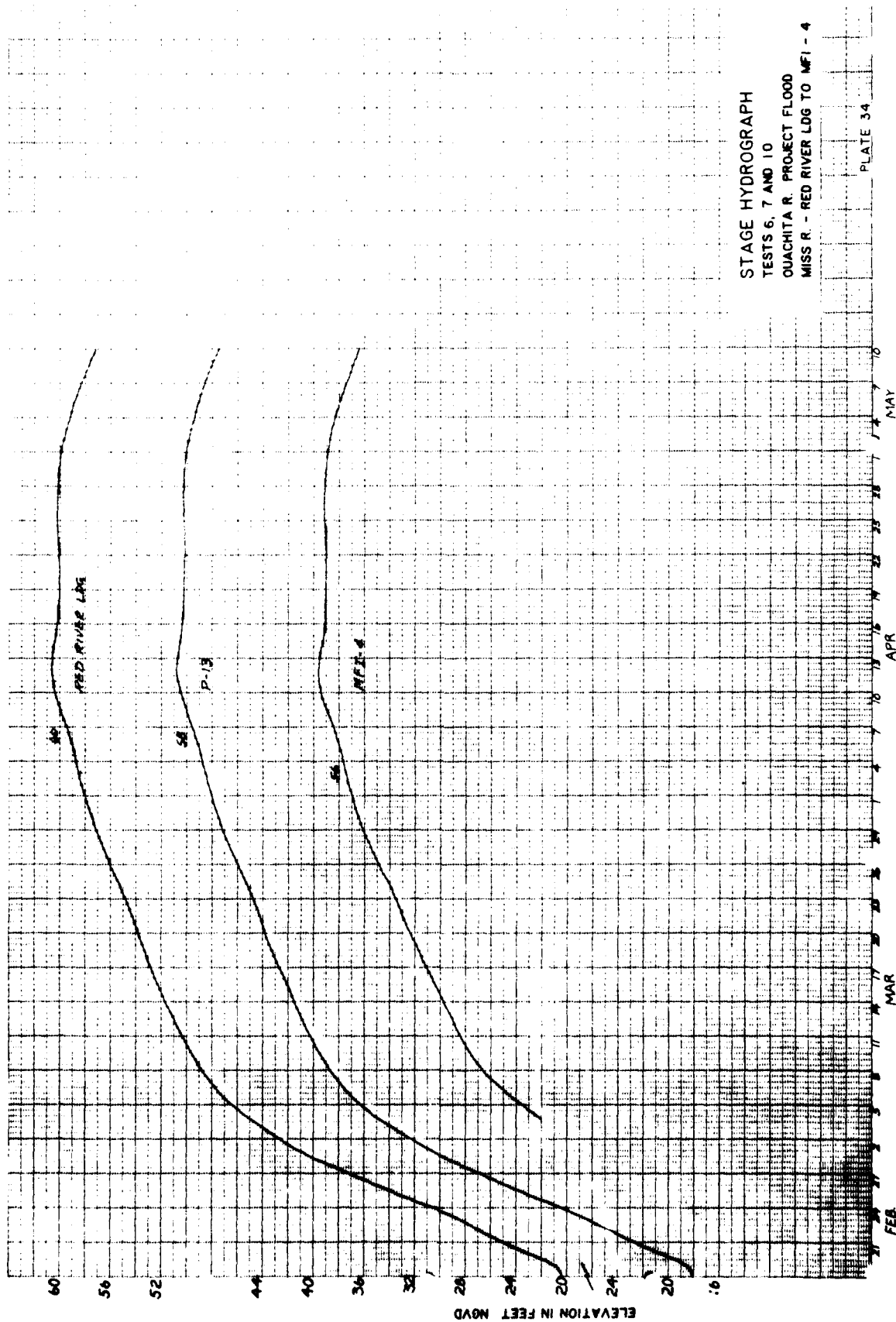
STAGE HYDROGRAPH
TESTS 6, 7 AND 10
OUACHITA R. PROJECT FLOOD
MISS R - G-1 TO LOWER GLASSCOCK

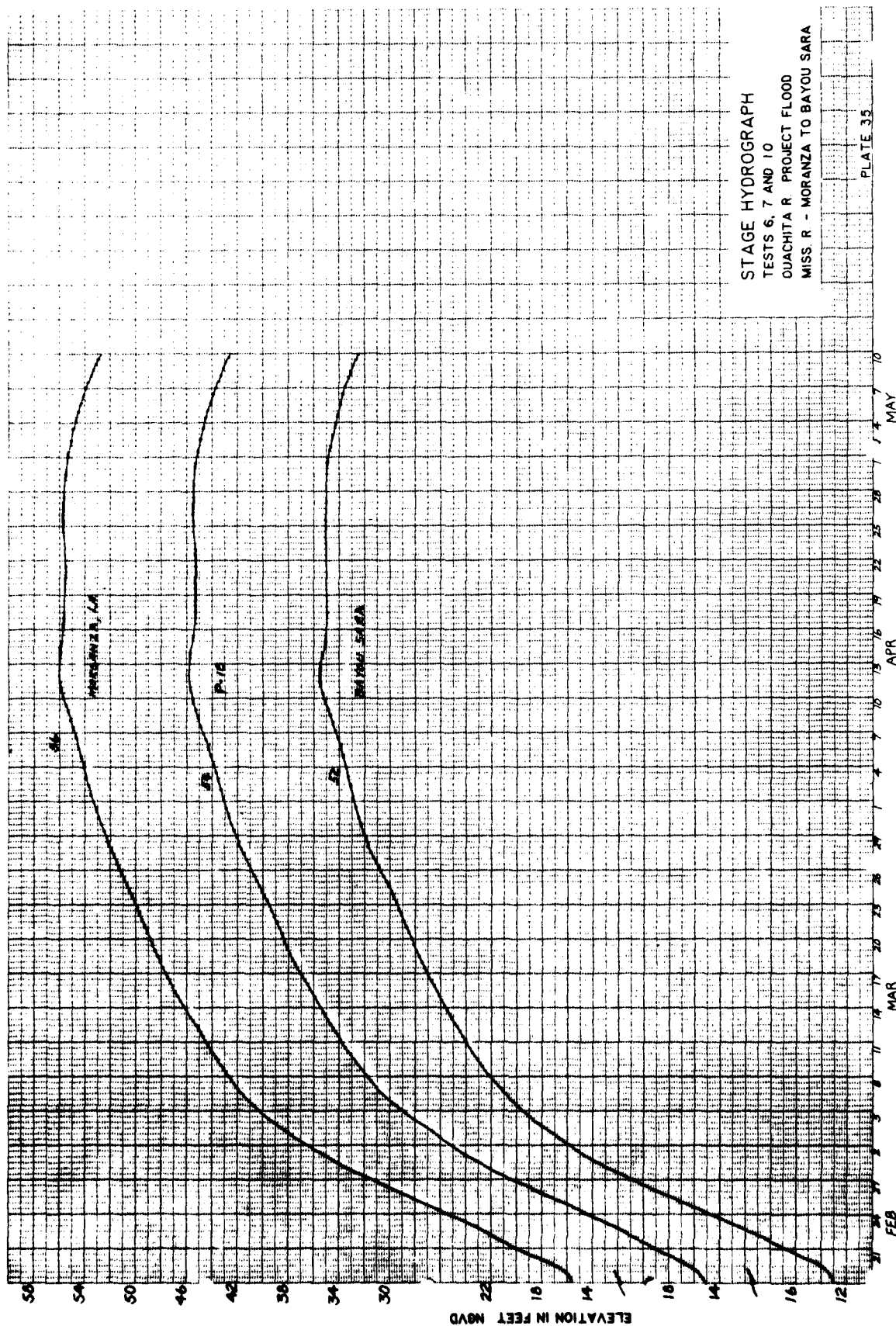
PLATE 31

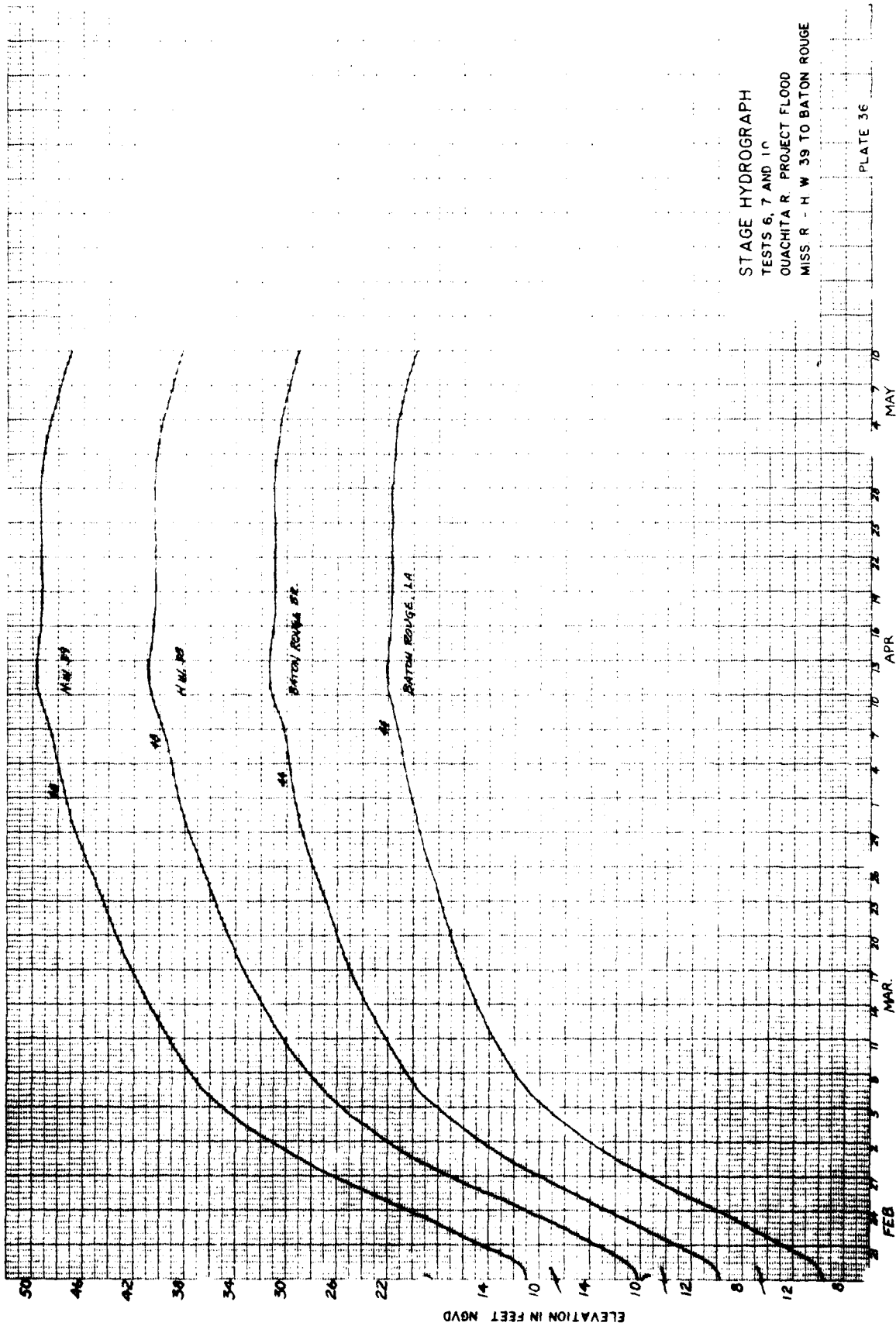


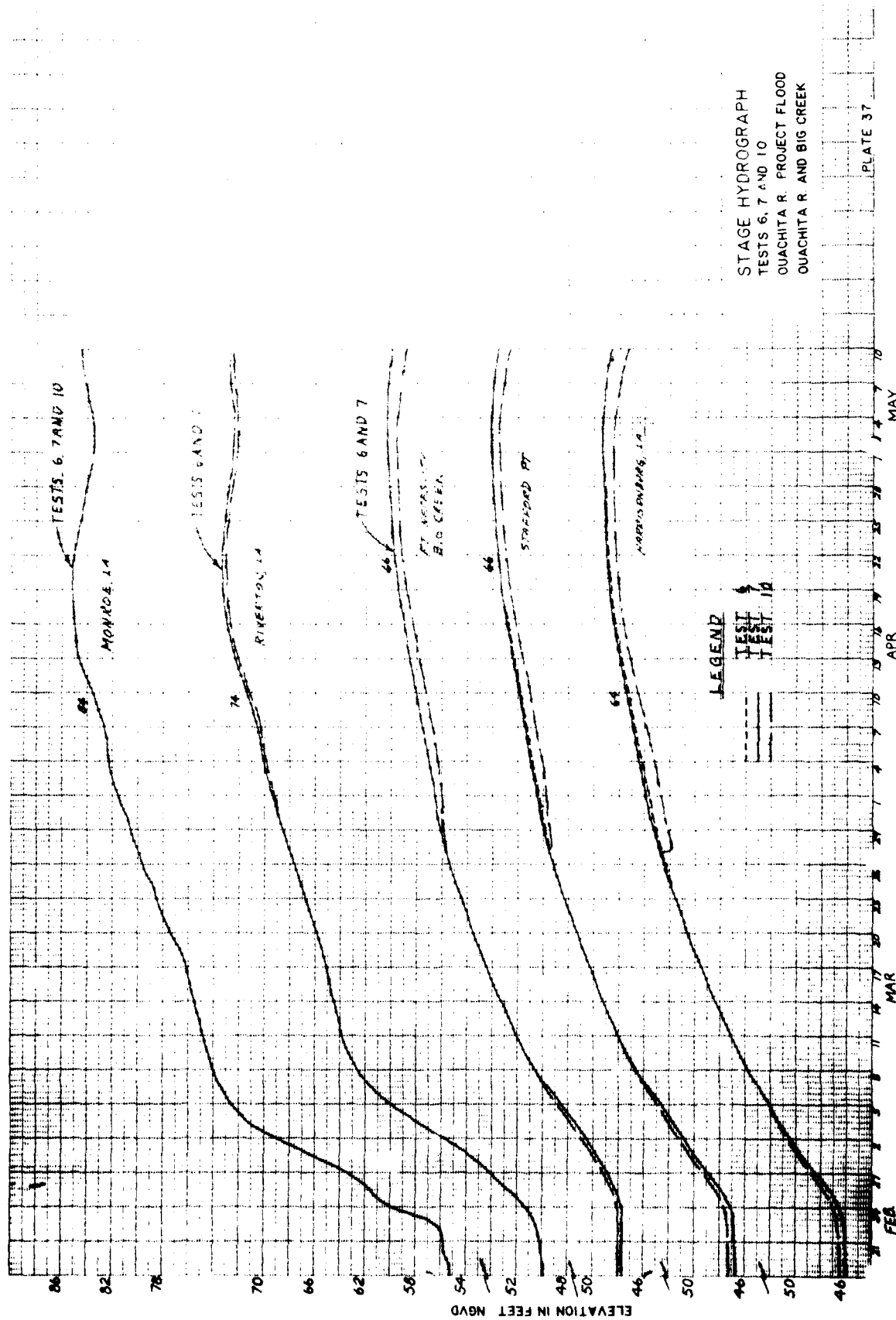


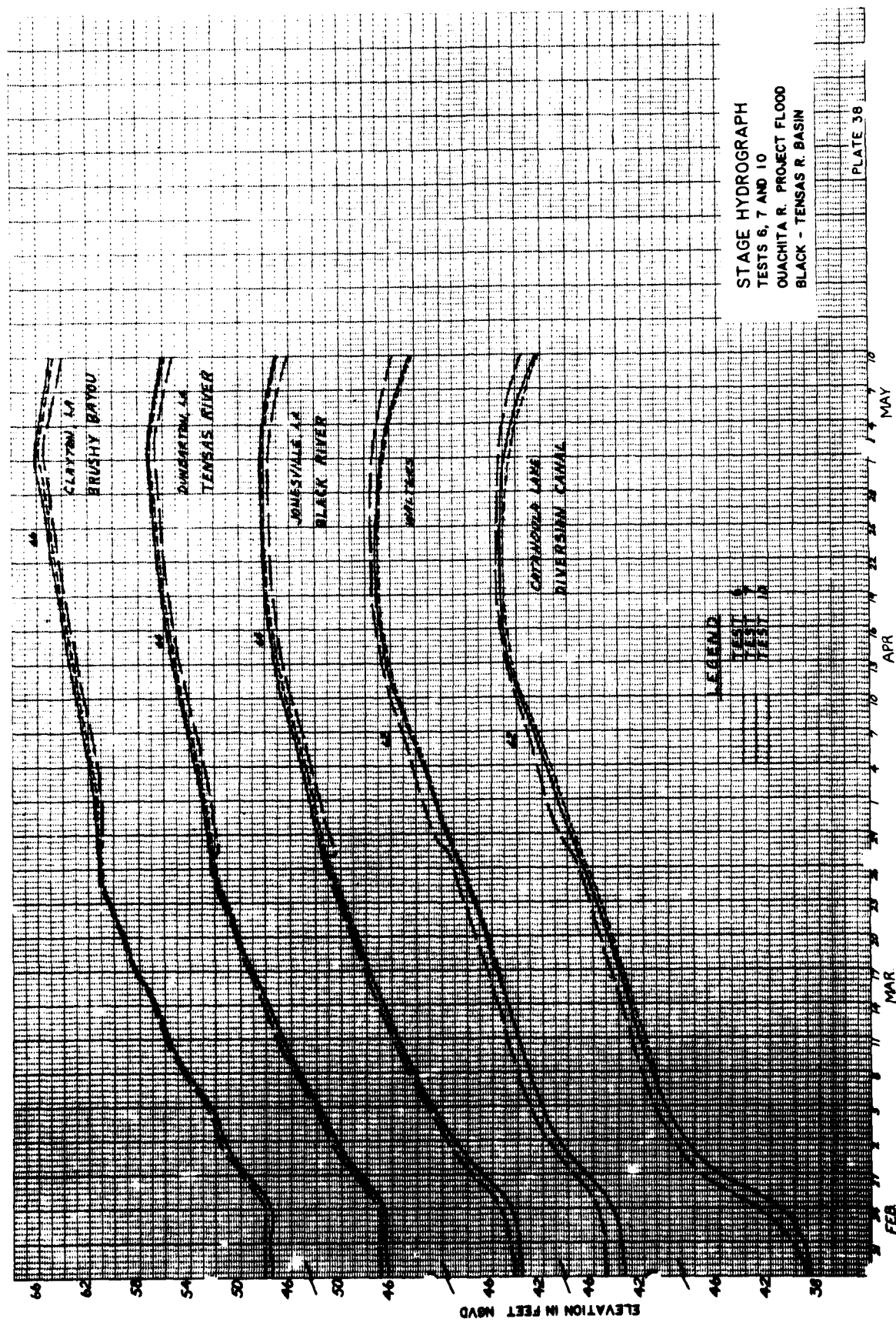
STAGE HYDROGRAPH
TESTS 6, 7 AND 10
OUACHITA R. PROJECT FLOOD
MISS R - KNOX LDG TO TORRAS

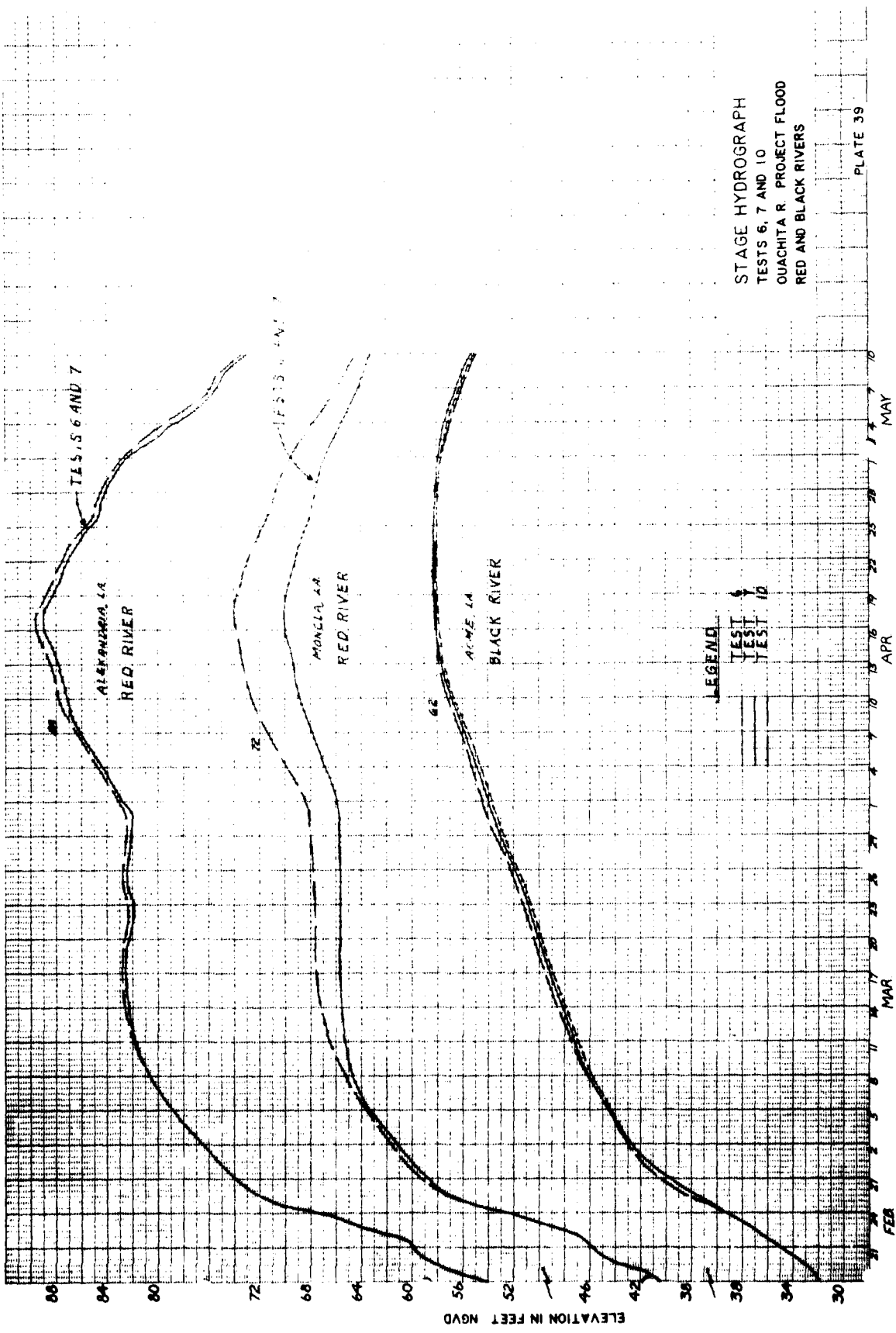


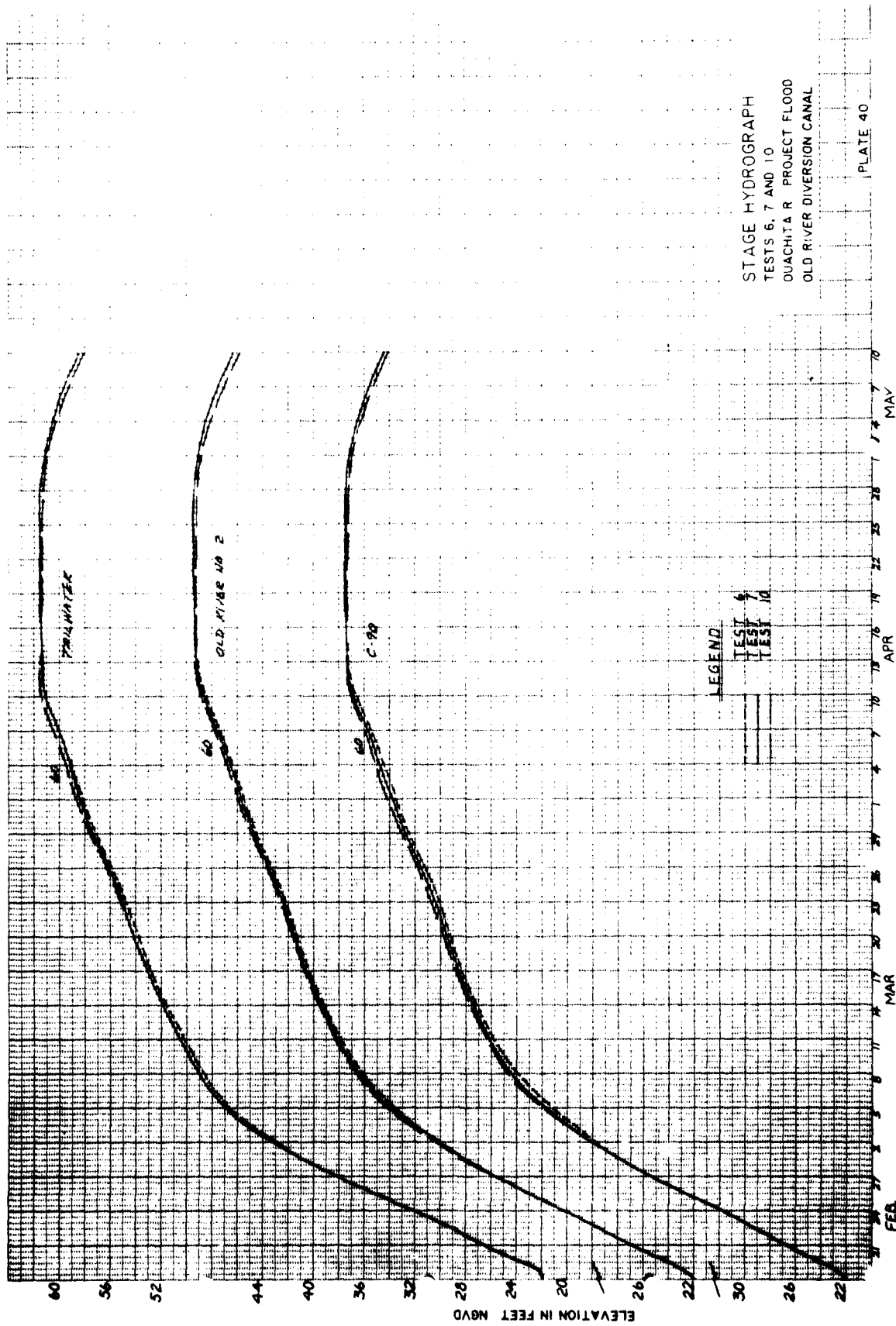


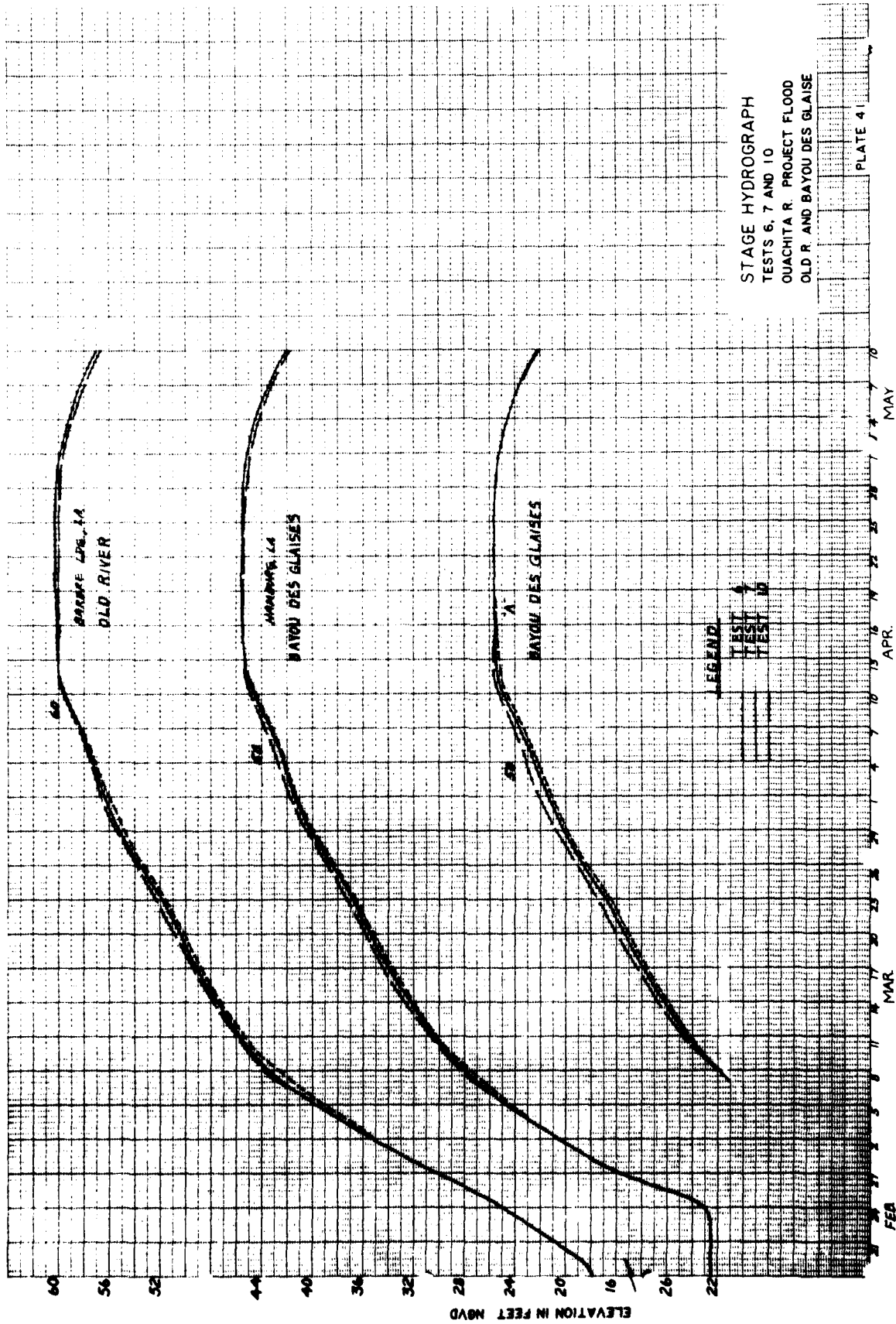


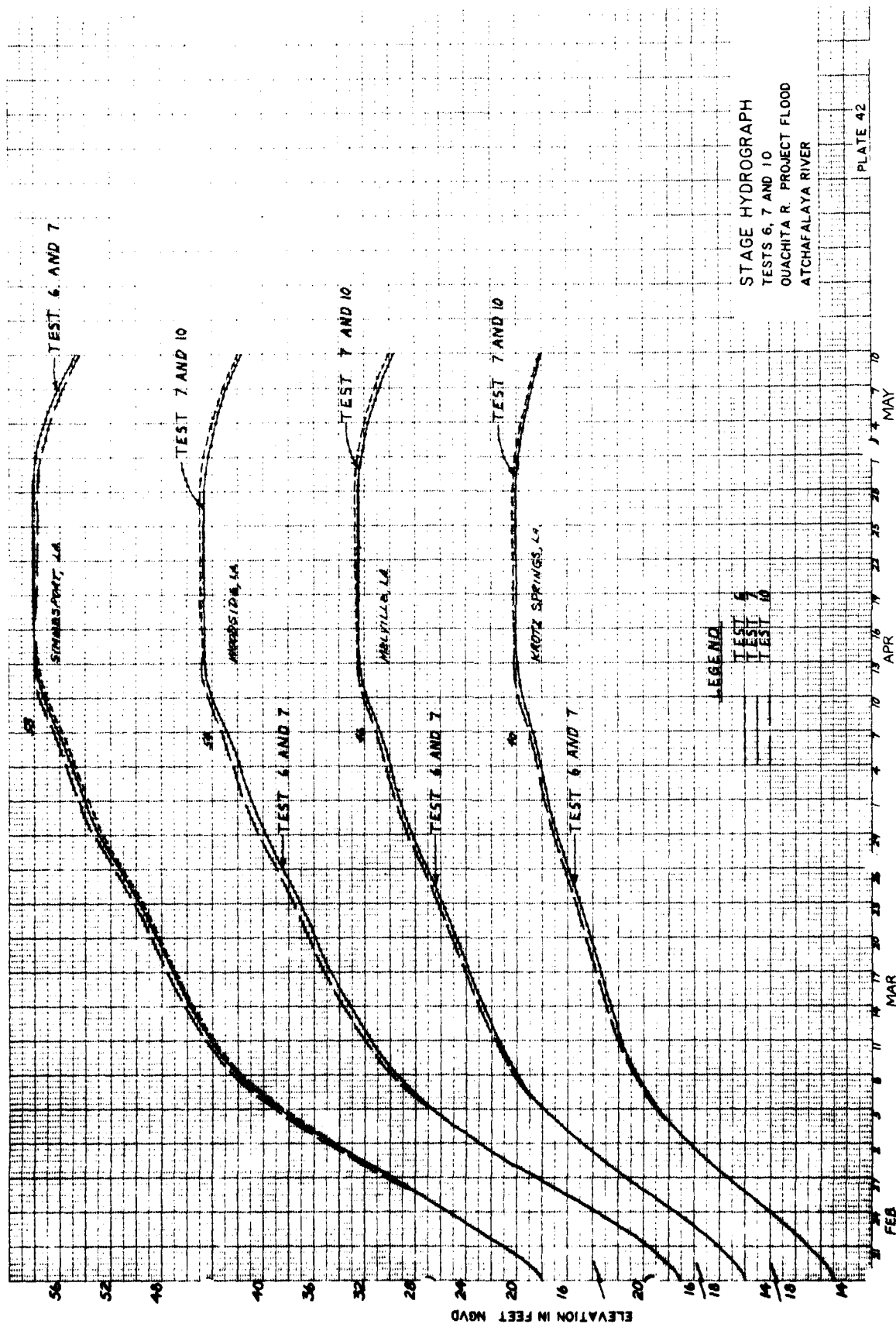


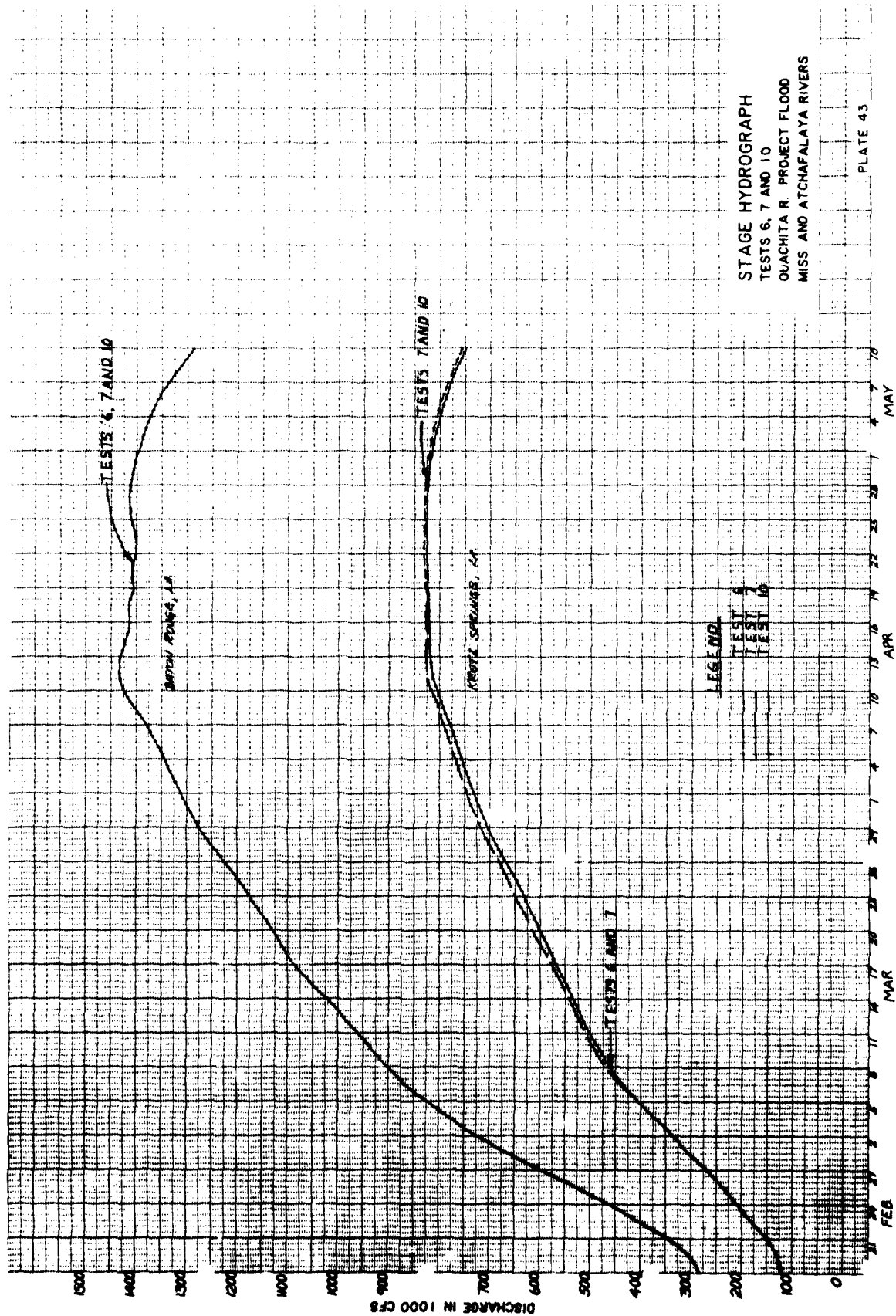












Key to Numbering of MRM Reports*

Type of Report or Test	General	LAWD	MRD	ORD	SUD	UNVD	Outside Agencies	Reserved for Future	Division	Basin-wide
General Reports	1-series									
MRM Board Meetings	2-series									
Reports in Technical Journals	3-series									
Reserved for Future	4-series									
Technical for Future	5-series									
Reserved for Future	6-series									
Technical for Future	7-series									
Reserved for Future	8-series									
Technical for Future	9-series									
Verification Studies	10-series	11-	12-	13-	14-	15-	16-	17-	18-	19-
Operatively-Operation Studies	20-series	21-	22-	23-	24-	25-	26-	27-	28-	29-
Other Studies	30-series	31-	32-	33-	34-	35-	36-	37-	38-	39-
Other-Testing Studies	40-series	41-	42-	43-	44-	45-	46-	47-	48-	49-
Changes in Region	50-series	51-	52-	53-	54-	55-	56-	57-	58-	59-
Reserved for Future	60-series	61-	62-	63-	64-	65-	66-	67-	68-	69-
Reserved for Future	70-series	71-	72-	73-	74-	75-	76-	77-	78-	79-
Miscellaneous Studies	80-series	81-	82-	83-	84-	85-	86-	87-	88-	89-
Combined Purpose Studies	90-series	91-	92-	93-	94-	95-	96-	97-	98-	99-

* First digit indicates type of report or test; second digit (for 10-series and above) indicates office for which performed. Numbers following dashes indicate chronological order in respective series.

END

DATE
FILMED

4 - 85

DT